Montana Department of Environmental Quality

Tobacco Planning Area Sediment TMDLs and Framework Water Quality Improvement Plan

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ACRONYMS

Acronym	Definition
AFO	Animal Feeding Operation
ARM	Administrative Rules of Montana
BEHI	Bank Erosion Hazard Index
BFW	Bankfull Width
BLM	Bureau of Land Management (Federal)
BMP	Best Management Practices
CAFO	Concentrated (or Confined) Animal Feed Operations
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CN	Curve Number
CWA	Clean Water Act
DEQ	Department of Environmental Quality (Montana)
DNRC	Department of Natural Resources & Conservation
EPA	Environmental Protection Agency (U.S.)
FS	Forest Service
FWP	Fish, Wildlife, and Parks (Montana)
GIS	Geographic Information System
INFISH	Inland Native Fish Strategy
IR	Integrated Report
KNF	Kootenai National Forest
KRN	Kootenai River Network
LA	Load Allocation
LWD	Large Woody Debris
MCA	Montana Code Annotated
MDEQ	Montana Department of Environmental Quality
MGD	Million Gallons per Day
MMI	Multi-Metric Index
MOS	Margin of Safety
MPDES	Montana Pollutant Discharge Elimination System
MSU	Montana State University
NBS	Near Bank Stress
NHD	National Hydrography Data[set]
NPS	Nonpoint Source
NRCS	National Resources Conservation Service
PIBO	PACFISH/INFISH Biological Opinion
RHCA	Riparian Habitat Conservation Area
SAP	Sampling and Analysis Plan
SMZ	Streamside Management Zone
SWPPP	Storm Water Pollution Prevention Plan
TMDL	Total Maximum Daily Load
TPA	TMDL Planning Area
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USFS	United States Forest Service

Acronym	**Definition**
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USLE	Universal Soil Loss Equation
VFS	Vegetated Filter Strips
WARSSS	Watershed Assessment of River Stability and Sediment Supply
WEPP	Water Erosion Prediction Project
WLA	Wasteload Allocation
WRP	Watershed Restoration Plans

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DOCUMENT SUMMARY

This document presents total maximum daily loads (TMDL) and a framework water quality improvement plan for eight streams in the Tobacco TMDL Planning Area (TPA), including the Tobacco River, Fortine Creek, Sinclair Creek, Therriault Creek, Deep Creek, Swamp Creek, Edna Creek, and Lime Creek (see **Map A-1** found in **Appendix A**). The Montana Department of Environmental Quality (DEQ) develops TMDLs and submits them to the U.S. Environmental Protection Agency (EPA) for approval. The Montana Water Quality Act requires DEQ to develop TMDLs for streams and lakes that do not meet, or are not expected to meet, Montana water quality standards. A TMDL is the maximum amount of a pollutant a waterbody can receive and still meet water quality standards. TMDLs provide an approach to improve water quality so that streams and lakes can support and maintain their state-designated beneficial uses.

The majority of the Tobacco River watershed is located in Lincoln County in northwest Montana, with a small section located in Flathead County (**Map A-1, Appendix A**). The Tobacco River watershed is sparsely populated. Eureka is the largest town with 1,017 residents, according to the 2000 census. The majority of the land (67.5%) in the Tobacco River watershed is public land managed by the United States Forest Service. Private land holdings account for 28.8% and are primarily located in the valley bottoms adjacent to stream corridors and in the vicinity of Eureka. Evergreen forest is the dominate land cover in the Tobacco River watershed at almost 75%. Only small areas of the watershed have been cultivated. Significant economic activities include rural land development and associated construction, forest management and associated timber products, and recreation.

The Tobacco River forms at the confluence of Grave and Fortine Creeks and flows into the Kootenai River at Lake Koocanusa near the town of Eureka. DEQ split the Tobacco watershed into two areas for TMDL development, one being the Grave Creek TMDL Planning Area (TPA), and the other the Tobacco TPA. A Grave Creek sediment TMDL was developed separately in 2005 (Montana Department of Environmental Quality, 2005). All TMDLs in this document address excess sediment within each of the eight streams identified above. Although DEQ recognizes that there are other pollutant impairment problems in the Tobacco TPA, such as temperature and nutrients, this document only provides TMDLs for sediment. Future TMDL work will be required to address the additional pollutant problems not addressed by the sediment TMDLs in this document.

Sediment was identified as impairing aquatic life and coldwater fishes. Excess sediment often alters aquatic insect communities, reduces fish spawning success, reduces desirable stream habitat, and increases turbidity. Water quality restoration goals (TMDL targets and TMDL allocations) focus on instream measures of sediment impacts and continued implementation of land management improvements to reduce excess sediment entering streams. DEQ believes that once the water quality goals are met, all water uses currently affected by sediment will be restored for the eight streams with sediment TMDLs.

Sediment loads were quantified for the following major source categories: bank erosion, upland erosion, roads, and construction stormwater runoff. Distinctions were made between natural and preventable human caused sediment loads for all source categories, with the most significant sediment loading linked historic timber harvest, unpaved road crossings, and removal or alteration of vegetation along streams. It is concluded that total sediment load reductions ranging from 8 to 25% for each stream will satisfy the TMDL water quality goals, with most reductions in the 8 to 14% range. These small reductions are consistent with potential water quality recovery from past practices and the fact that several streams are close to satisfying the water quality goals based on the instream measures of sediment impacts.

Recommended strategies for achieving the sediment reduction goals are also presented in this plan. They include best management practices (BMPs) for building and maintaining roads, for harvesting timber, for grazing livestock, and for developing subdivisions. Implementation of most water quality improvement measures described in this plan is based on voluntary actions by watershed stakeholders and landowners. Ideally, local watershed groups and/or other watershed stakeholders will use this TMDL document, and associated information, as a tool to guide local water quality improvement activities. Such activities can be documented within a locally developed watershed restoration plan consistent with DEQ and EPA recommendations.

A flexible approach to most TMDL implementation activities is necessary. This can be accomplished via adaptive management linked to additional knowledge gained through BMP implementation and future monitoring. The plan includes a monitoring strategy designed to track progress in meeting TMDL objectives and goals and to help refine the plan during its implementation.

Table DS-1 summarizes the Tobacco TPA streams with sediment TMDLs prepared within this document. The sediment TMDLs were written for *sedimentation / siltation* impairment causes.

Table DS-1. Waterbodies in the Tobacco TMDL Planning Area with Completed Sediment TMDLs Contained in this Document

Waterbody & Location Description	Waterbody ID	Impairment Cause	Type of TMDL Prepared	Impaired Uses
Deep Creek, headwaters to mouth (Fortine Creek)	MT76D004_080	Sedimentation / Siltation*	**Sediment***	Aquatic Life, Cold Water Fishery
Edna Creek, headwaters to mouth (Fortine Creek)	MT76D004_030	Sedimentation / Siltation	**Sediment**	Aquatic Life
Fortine Creek, headwaters to mouth (Grave Creek)	MT76D004_020	Sedimentation / Siltation	**Sediment***	Aquatic Life, Cold Water Fishery
Lime Creek, headwaters to mouth (Fortine Creek)	MT76D004_050	Sedimentation / Siltation	**Sediment***	Aquatic Life, Cold Water Fishery
Sinclair Creek**, confluence of un-named tributary, Lat -114.945 Long 48.908, to mouth (Tobacco River)	MT76D004_091	Sedimentation / Siltation	**Sediment**	Aquatic Life, Cold Water Fishery
Swamp Creek, headwaters to mouth (Fortine Creek)	MT76D004_040	Sedimentation / Siltation	**Sediment***	Aquatic Life, Cold Water Fishery
Therriault Creek, headwaters to mouth (Tobacco River)	MT76D004_070	Sedimentation / Siltation	**Sediment**	Aquatic Life, Cold Water Fishery
Tobacco River, confluence of Grave Creek & Fortine Creek to mouth (Lake Koocanusa)	MT76D004_010	Sedimentation / Siltation	**Sediment***	Aquatic Life, Cold Water Fishery

* Sediment TMDL also addresses a closely linked habitat alteration impairment cause

** Sinclair Creek was investigated per stakeholder recommendations; a sediment TMDL was prepared because the water quality results are consistent with sediment impairment

1.0 INTRODUCTION

This document presents an analysis of water quality information and establishes total maximum daily loads (TMDLs) for sediment problems in the Tobacco TMDL Planning Area (TPA). This document also presents a general framework for resolving these problems. **Map A-1** found in **Appendix A** shows a map of the waterbodies in the TPA for which sediment TMDLs were developed.

1.1 BACKGROUND

In 1972, the U.S. Congress passed the Water Pollution Control Act, more commonly known as the Clean Water Act (CWA). The CWA's goal is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The CWA requires each state to designate uses of their waters and to develop water quality standards to protect those uses. Each state must monitor their waters to track if they are supporting their designated uses.

Montana's water quality designated use classification system includes the following uses:

- fish and aquatic life
- wildlife
- recreation
- agriculture
- industry
- drinking water

Each waterbody has a set of designated uses. Montana has established water quality standards to protect these uses. Waterbodies that do not meet one or more standards are called impaired waters. Every two years DEQ must file a Water Quality Integrated Report (IR), which lists all impaired waterbodies and their identified causes. Impairment causes fall within two main categories: pollutant and non-pollutant.

Montana's biennial IR identifies all the state's impaired waterbody segments, all of which are indexed to the National Hydrography Dataset (NHD). The 303(d) list portion of the IR includes all of those waterbody segments impaired by a pollutant, which require a TMDL. TMDLs are not required for non-pollutant impairments. **Table A-1** in **Appendix A** identifies impaired waters for the Tobacco TPA from Montana's 2010 303(d) List, as well as non-pollutant impairment causes included in Montana's "2010 Water Quality Integrated Report." **Table A-1** provides the current status of each impairment cause, identifying whether it has been addressed by TMDL development.

Both Montana state law (Section 75-5-701 of the Montana Water Quality Act) and section 303(d) of the federal CWA require the development of total maximum daily loads for all impaired waterbodies when water quality is impaired by a pollutant. A TMDL is the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards.

Developing TMDLs and water quality improvement strategies includes the following components, which are further defined in **Section 4.0**:

- Determining measurable target values to help evaluate the waterbody's condition in relation to the applicable water quality standards
- Quantifying the magnitude of pollutant contribution from their sources

- Determining the TMDL for each pollutant based on the allowable loading limits for each waterbody-pollutant combination
- Allocating the total allowable load (TMDL) into individual loads for each source

In Montana, restoration strategies and monitoring recommendations are also incorporated in TMDL documents to help facilitate TMDL implementation.

Basically, developing a TMDL for an impaired waterbody is a problem-solving exercise: The problem is excess pollutant loading that impairs a designated use. The solution is developed by identifying the total acceptable pollutant load (the TMDL), identifying all the significant pollutant-contributing sources, and identifying where pollutant loading reductions should be applied to achieve the acceptable load.

1.2 Water Quality Impairments and TMDLs Addressed by this Document

Table 1-1 below lists all of the sediment and sediment–related impairment causes from the “2010 Water Quality Integrated Report” that are addressed in this document (also see **Map 1** in **Appendix A**). Additionally, data collected on the lower segment of Sinclair Creek (MT76D004_091) during this project indicated a sediment water quality problem. Because many of the water quality targets were not satisfied for Sinclair Creek (see **Section 5.4.2.5**), a TMDL was written for this segment.

TMDLs are completed for each waterbody – pollutant combination, and this document contains eight TMDLs (seven identified in **Table 1-1** plus Sinclair Creek). There are several non-pollutant types of impairment that are also addressed in this document. As noted above, TMDLs are not required for non-pollutants, although in many situations the solution to one or more pollutant problems will be consistent with, or equivalent to, the solution for one or more non-pollutant problems. **Section 6** provides some basic water quality solutions to address both the sediment-related non-pollutant causes and sediment pollutant causes of impairment.

Although DEQ recognizes that there are other pollutant listings for the Tobacco TPA without completed TMDLs (**Table A-1** in **Appendix A**), this document only addresses those identified in **Table 1-1**. This is because DEQ sometimes develops TMDLs in a watershed at varying phases, with a focus on one or a couple of specific pollutant types. Future TMDL work will be required to address the additional pollutant problems not addressed by the sediment TMDLs in this document.

Table 1-1. Water Quality Impairment Causes for the Tobacco TMDL Planning Area in the “2010 Water Quality Integrated Report” Addressed within this Document

Waterbody & Location Description	Waterbody ID	Impairment Cause	Pollutant Category	Impairment Cause Status
Deep Creek, headwaters to mouth (Fortine Creek)	MT76D004_080	Alteration in stream-side or littoral vegetative covers	Not Applicable: Non-Pollutant	Addressed by sediment TMDL
		Sedimentation / Siltation	Sediment	Sediment TMDL completed
Edna Creek, headwaters to mouth (Fortine Creek)	MT76D004_030	Sedimentation / Siltation	Sediment	Sediment TMDL completed
Fortine Creek, headwaters to mouth (Grave Creek)	MT76D004_020	Alteration in stream-side or littoral vegetative covers	Not Applicable: Non-Pollutant	Addressed by sediment TMDL
		Sedimentation / Siltation	Sediment	Sediment TMDL completed

Table 1-1. Water Quality Impairment Causes for the Tobacco TMDL Planning Area in the "2010 Water Quality Integrated Report" Addressed within this Document

Waterbody & Location Description	Waterbody ID	Impairment Cause	Pollutant Category	Impairment Cause Status
Lime Creek, headwaters to mouth (Fortine Creek)	MT76D004_050	Alteration in stream-side or littoral vegetative covers	Not Applicable: Non-Pollutant	Addressed by sediment TMDL
		Sedimentation / Siltation	Sediment	Sediment TMDL completed
Swamp Creek, headwaters to mouth (Fortine Creek)	MT76D004_040	Alteration in stream-side or littoral vegetative covers	Not Applicable: Non-Pollutant	Addressed by sediment TMDL
		Sedimentation / Siltation	Sediment	Sediment TMDL completed
Therriault Creek, headwaters to mouth (Tobacco River)	MT76D004_070	Siltation, Sedimentation	Sediment	Sediment TMDL completed
Tobacco River, confluence of Grave Creek & Fortine Creek to mouth (Lake Koocanusa)	MT76D004_010	Physical substrate habitat alterations	Not Applicable: Non-Pollutant	Addressed by sediment TMDL
		Sedimentation / Siltation	Sediment	Sediment TMDL completed

1.3 Document Layout

This document addresses all of the required components of a TMDL and includes an implementation and monitoring strategy. The TMDL components are summarized within the main body of the document. Additional technical details are contained in the appendices. In addition to this introductory section, this document includes:

Section 2.0 Tobacco River Watershed Description:
Describes the physical characteristics and social profile of the watershed.

Section 3.0 Montana Water Quality Standards:
Discusses the water quality standards that apply to the Tobacco River watershed.

Section 4.0 Defining TMDLs and Their Components:
Defines the components of TMDLs and how each is developed.

Section 5.0 Sediment TMDL Development:
This section includes (a) a discussion of the affected waterbodies and the pollutant's effect on designated beneficial uses, (b) the information sources and assessment methods used to evaluate stream health and pollutant source contributions, (c) water quality targets and existing water quality conditions, (d) the quantified pollutant loading from the identified sources, (e) the determined TMDL for each waterbody, (f) the allocations of the allowable pollutant load to the identified sources.

Section 6.0 TMDL Implementation Framework: Water Quality Restoration and Monitoring Recommendations:
Discusses water quality restoration objectives and presents a framework monitoring strategy to meet the identified objectives and TMDLs.

Section 7.0 Public Participation:
Describes other agencies and stakeholder groups who were involved with the planning and development of this document, and the public participation process used during this project.

2.0 TOBACCO RIVER WATERSHED DESCRIPTION

This section includes a summary of the physical and social profile of the Tobacco River watershed excerpted from the "Tobacco River Watershed Description." The entire watershed description is contained in **Appendix B**; associated maps are contained in **Appendix A**.

2.1 PHYSICAL CHARACTERISTICS

The following information describes the physical characteristics of the Tobacco River watershed.

2.1.1 Location

The majority of the Tobacco River watershed is located in Lincoln County in northwest Montana, with a small section (a portion of the Lime Creek watershed) located in Flathead County (**Map A-1**, **Appendix A**). The Tobacco River is a fifth order watershed draining approximately 440 mi^2 (282,000 acres) between the Kootenai River on the west, the Whitefish Range on the east, and the Salish Mountains to the south. The Tobacco River is located south of the United States-Canadian border and north of the Fisher River watershed. The Tobacco River forms at the confluence of Grave and Fortine Creeks and flows into the Kootenai River at Lake Koocanusa near the town of Eureka. The mainstem of the Tobacco River and six tributaries are included on the 2010 303(d) List of impaired waterbodies. These tributaries include: Edna, Fortine, Grave, Lime, Swamp and Therriault Creeks (**Map A-1, Appendix A**).

2.1.2 Climate

The average precipitation ranges from 16 inches/year at Fortine and 14 inches/year at Eureka, while average snowfall averages between 47 and 60 inches/year at higher elevations. May and June are consistently the wettest months of the year and winter precipitation is dominated by snowfall. Temperature patterns reveal that July is the hottest month and January is the coldest throughout the watershed. Summertime highs are typically in the high 70s to low 80s Fahrenheit, and winter lows fall to approximately 11˚F. **Map A-2** in **Appendix A** shows the average annual precipitation in the Tobacco River watershed.

2.1.3 Hydrology

Streamflows are at their highest between May and June, which also sees the greatest amount of precipitation. Historical data indicate peak flows on the Tobacco River in May average approximately 750 cubic feet per second (cfs). However, flows from 2,300 to 3,180 cfs have been recorded in the month of May. The last 50 years of data from the Tobacco River USGS gaging station show on average a mean monthly discharge below 150 cfs for August through February. Rain on snow events occur periodically in early fall or spring, producing high flows over short periods of time.

2.1.4 Geology and Soils

Much of the soil in the Tobacco valley is relatively erodible as it is compiled of glacial deposits that create sandy loams (**Maps A-3** and **A-4**, **Appendix A**). Majority of the bedrock in the area belongs to the Belt Supergroup of Precambrian age. Highly erodible, unconsolidated Quaternary alluvium is found in the Grave Creek valley bottom and lower Tobacco River. Belt series rock is found in the Swamp Creek, Grave Creek, and upper Fortine and Meadow areas.

2.2 Social Profile

The following information describes the social profile of the Tobacco River watershed.

2.2.1 Land Ownership

The majority of the land (67.5% or 298 square miles) in the Tobacco River watershed is public land managed by the U.S. Forest Service. Private land holdings account for 28.8% (127 square miles) and are primarily located in the valley bottoms adjacent to stream corridors. The remaining 3.8% of land is owned by the state of Montana (2.6%), Plum Creek Timber Company (0.3%), The Nature Conservancy (0.2%), and the U.S. Bureau of Reclamation (0.1%). **Map A-6** in **Appendix A** shows land ownership in the Tobacco River watershed.

2.2.2 Land Use and Land Cover

Evergreen forest is the dominate land cover in the Tobacco River watershed at almost 75%. Shrubland comprises just over 10% and grasslands/herbaceous makes up approximately 7% of the land area. In direct correlation, timber production is the primary land use in the watershed. Historically, much of the watershed has been logged and riparian habitat altered by log drives, riparian harvest, and road construction. Only small areas of the watershed have been cultivated. **Map A-5** in **Appendix A** shows the types of land cover and land use of the Tobacco River watershed.

2.2.3 Population

The Tobacco River watershed is sparsely populated. Eureka is the largest town with 1,017 residents, according to the 2000 census. Census data indicates the population is growing with a count of 4,000 people in the watershed in 2000 and 5,423 in 2007. Primary employment is in services, retail trade, and manufacturing.

2.3 Fish and Aquatic Life

As a tributary to the Kootenai River, the Tobacco River and its tributaries provide important spawning and rearing habitat for fluvial and adfluvial fish populations that produce some of western Montana's popular sport fisheries, such as brook trout (*Salvelinus fontinalis)* and rainbow trout (*Oncorhynchus mykiss*). Streams in this watershed also support species of special concern, including Westslope cutthroat trout (*Oncorhynchus clarkii lewisi*), Bull trout (*Salvelinus confluentus)* and Torrent sculpin *(Cottus rhotheus)*. Westslope cutthroat trout are found throughout the watershed, but may be mostly hybridized except in isolated headwater stream segments (**Map A-9**, **Appendix A**). Bull trout are also listed as threatened under the Endangered Species Act. Most Bull trout from Lake Koocanusa migrate up the Tobacco River and spawn in Grave Creek where the population appears stable or increasing based on redd and juvenile counts for the past 10 to 15 years. **Map A-10** in **Appendix A** shows the distribution of bull trout in the Tobacco River watershed. In Montana, the Torrent sculpin is found only in the Kootenai River system. The Torrent sculpin is listed as a state sensitive species, but is known to inhabit the Tobacco River and its tributaries.

3.0 Montana Water Quality Standards

The federal Clean Water Act provides for the restoration and maintenance of the chemical, physical, and biological integrity of the nation's surface waters so that they support all designated uses. Water quality standards are used to determine impairment, establish water quality targets, and to formulate the TMDLs and allocations.

Montana's water quality standards include four main parts:

1. Stream classifications and designated uses
2. Numeric and narrative water quality criteria designed to protect designated uses
3. Nondegradation provisions for existing high-quality waters
4. Prohibitions of practices that degrade water quality

Those components that apply to this document are reviewed briefly below. More detailed descriptions of Montana's water quality standards that apply to the Tobacco TMDL Planning Area streams can be found **Appendix C**.

3.1 Tobacco TMDL Planning Area Stream Classifications and Designated Beneficial Uses

Waterbodies are classified based on their designated uses. All Montana waters are classified for multiple uses. All streams and lakes within the Tobacco River watershed, other than Deep Creek, are classified as B-1, which specifies that the water must be maintained suitable to support all of the following uses:

- Drinking, culinary, and food processing purposes after conventional treatment
- Bathing, swimming, and recreation
- Growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers
- Agricultural and industrial waters supply

Deep Creek is classified as A-1, which must be maintained suitable for all of the same uses as B-1, as well as drinking, culinary and food processing purposes after conventional treatment for removal of naturally present impurities. At the time Deep Creek was classified, it was apparently being used as the drinking water supply for the town of Fortine. The language "for removal of naturally occurring impurities" implies a higher level of protection, given the drinking water use.

While some of the waterbodies might not actually be used for a designated use (e.g., drinking water supply), their water quality still must be maintained suitable for that designated use. More detailed descriptions of Montana's surface water classifications and designated uses are provided in **Appendix C**.

Seven waterbody segments in the Tobacco TPA are listed in the "2010 Water Quality Integrated Report" as not supporting or partially supporting one or more designated uses (**Table 3-1**). Waterbodies that are "not supporting" or "partially supporting" a designated use are impaired and require a TMDL.

DEQ describes impairment as either partially supporting or not supporting, based on assessment results. Not supporting is applied to not meeting a drinking water standard, and is also applied to conditions where the assessment results indicate a severe level of impairment of aquatic life or coldwater fishery. A non-supporting level of impairment does not equate to complete elimination of the use.

Table 3-1. Waterbodies in the Tobacco TMDL Planning Area in Montana's "2010 Water Quality Integrated Report" and their Beneficial Use Support Status

Waterbody & Location Description	Waterbody ID	Use Class	Agriculture	Aquatic Life	Cold Water Fishery	Drinking Water	Industry	Primary Contact Recreation
Deep Creek, headwaters to mouth (Fortine Creek)	MT76D004_080	A-1	F	P	P	F	F	P
Edna Creek, headwaters to mouth (Fortine Creek)	MT76D004_030	B-1	F	P	F	F	F	F
Fortine Creek, headwaters to mouth (Grave Creek)	MT76D004_020	B-1	F	P	P	F	F	P
Lime Creek, headwaters to mouth (Fortine Creek)	MT76D004_050	B-1	F	N	N	N	F	P
Swamp Creek, headwaters to mouth (Fortine Creek)	MT76D004_040	B-1	F	P	P	F	F	P
Therriault Creek, headwaters to mouth (Tobacco River)	MT76D004_070	B-1	F	P	P	F	F	F
Tobacco River, confluence of Grave Creek & Fortine Creek to mouth (Lake Koocanusa)	MT76D004_010	B-1	F	P	P	F	F	F

F = Fully Supporting, P = Partially Supporting, N = Not Supporting

3.2 Water Quality Standards

In addition to the use classifications described above, Montana's water quality standards include numeric and narrative criteria that are designed to protect the designated uses. For the sediment TMDL development process in the Tobacco TPA, only the narrative standards are applicable.

Narrative standards are developed when there is insufficient information to develop specific numeric standards. Narrative standards describe either the allowable condition or an allowable increase of a pollutant above "naturally occurring" conditions. DEQ uses the naturally occurring condition, called a "reference condition," to determine whether or not narrative standards are being met (see **Appendix C**).

Reference defines the condition a waterbody could attain if all reasonable land, soil, and water conservation practices were put in place. Reasonable land, soil, and water conservation practices usually include, but are not limited to, best management practices (BMPs).

The specific sediment narrative water quality standards that apply to the Tobacco River watershed are summarized below. More detailed descriptions of Montana's surface water standards and Montana's reference approach are provided in **Appendix C**.

The specific sediment narrative water quality standards that apply to the Tobacco TPA are summarized in **Appendix C**.

4.0 DEFINING TMDLS AND THEIR COMPONENTS

A Total Maximum Daily Load (TMDL) is a tool for implementing water quality standards and is based on the relationship between pollutant sources and water quality conditions. More specifically, a TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive from all sources and still meet water quality standards.

Pollutant sources are generally defined as two categories: point sources and nonpoint sources. Point sources are discernible, confined and discrete conveyances, such as pipes, ditches, wells, containers, or concentrated animal feeding operations, from which pollutants are being, or may be, discharged. Some sources such as return flows from irrigated agriculture are not included in this definition. All other pollutant loading sources are considered nonpoint sources. Nonpoint sources are diffuse and are typically associated with runoff, streambank erosion, most agricultural activities, atmospheric deposition, and groundwater seepage. Natural background loading is a type of nonpoint source.

As part of TMDL development, the allowable load is divided among all significant contributing point and nonpoint sources. For point sources, the allocated loads are called "wasteload allocations" (WLAs). For nonpoint sources, the allocated loads are called "load allocations" (LAs).

A TMDL is expressed by the equation: $TMDL = \Sigma WLA + \Sigma LA$, where:

ΣWLA is the sum of the wasteload allocation(s) (point sources)
ΣLA is the sum of the load allocation(s) (nonpoint sources)

TMDL development must include a margin of safety (MOS), which can be explicitly incorporated into the above equation. Alternatively, the MOS can be implicit in the TMDL. A TMDL must also ensure that the waterbody will be able to meet and maintain water quality standards for all applicable seasonal variations (e.g., pollutant loading or use protection).

Development of each TMDL has four major components:

- Determining water quality targets
- Quantifying pollutant sources
- Establishing the total allowable pollutant load
- Allocating the total allowable pollutant load to their sources

Although the way a TMDL is expressed can vary by pollutant, these four components are common to all TMDLs, regardless of pollutant. Each component is described in further detail in the following subsections.

Figure 4-1 illustrates how numerous sources contribute to the existing load and how the TMDL is defined. The existing load can be compared to the allowable load to determine the amount of pollutant reduction needed.

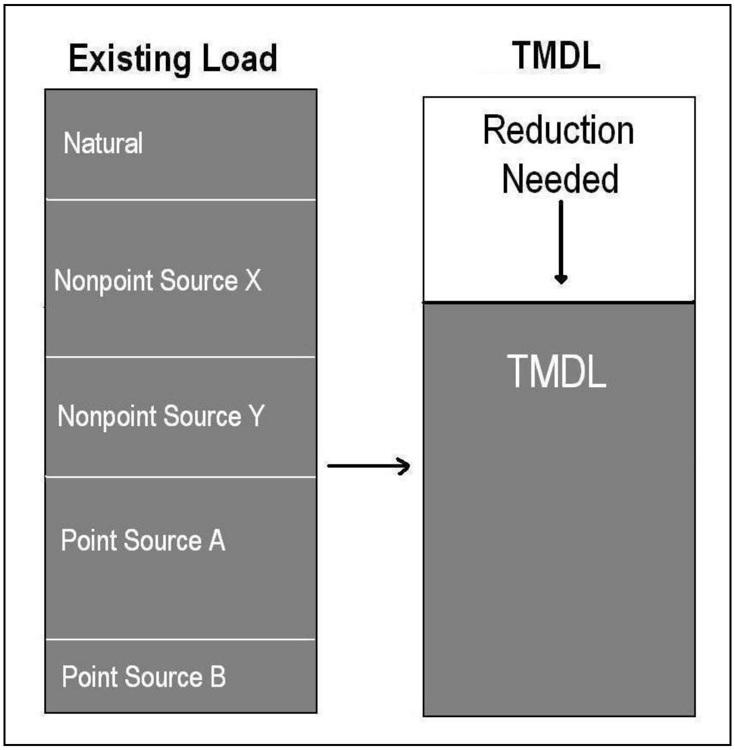

Figure 4-1. Schematic Example of TMDL Development

4.1 Developing Water Quality Targets

TMDL water quality targets are a translation of the applicable numeric or narrative water quality standard(s) for each pollutant. For pollutants with established numeric water quality standards, the numeric value(s) are used as the TMDL targets. For pollutants with narrative water quality standard(s), the targets provide a waterbody-specific interpretation of the narrative standard(s).

Water quality targets are typically developed for multiple parameters that link directly to the impaired beneficial use(s) and applicable water quality standard(s). Therefore, the targets provide a benchmark by which to evaluate attainment of water quality standards. Furthermore, comparing existing stream conditions to target values allows for a better understanding of the extent and severity of the problem.

4.2 Quantifying Pollutant Sources

All significant pollutant sources, including natural background loading, are quantified so that the relative pollutant contributions can be determined. Because the effects of pollutants on water quality can vary throughout the year, assessing pollutant sources must include an evaluation of the seasonal variability of the pollutant loading. The source assessment helps to define the extent of the problem by linking the pollutant load to specific sources in the watershed.

A pollutant load is usually quantified for each point source permitted under the Montana Pollutant Discharge Elimination System (MPDES) program. Nonpoint sources are quantified by source categories (e.g., unpaved roads) and/or by land uses (e.g., forestry). These source categories and land uses can be divided further by ownership, such as federal, state, or private. Alternatively, most, or all, pollutant sources in a sub-watershed or source area can be combined for quantification purposes.

Because all potentially significant sources of the water quality problems must be evaluated, source assessments are conducted on a watershed scale. The source quantification approach may produce reasonably accurate estimates or gross allotments, depending on the data available and the techniques used for predicting the loading (40 CFR Section 130.2(I)). Montana TMDL development often includes a combination of approaches, depending on the level of desired certainty for setting allocations and guiding implementation activities.

4.3 Establishing the Total Allowable Load

Identifying the TMDL requires a determination of the total allowable load over the appropriate time period necessary to comply with the applicable water quality standard(s). Although “TMDL” implies “daily load,” determining a daily loading may not be consistent with the applicable water quality standard(s), or may not be practical from a water quality management perspective. Therefore, the TMDL will ultimately be defined as the total allowable loading during a time period that is appropriate for applying the water quality standard(s) and which is consistent with established approaches to properly characterize, quantify, and manage pollutant sources in a given watershed. For example, sediment TMDLs may be expressed as an allowable annual load.

If a stream is impaired by a pollutant for which numeric water quality criteria exist, the TMDL, or allowable load, is typically calculated as a function of streamflow and the numeric criteria. This same approach can be applied when a numeric target is developed to interpret a narrative standard.

Some narrative standards, such as those for sediment, often have a suite of targets. In many of these situations it is difficult to link the desired target values to highly variable, and often episodic, instream loading conditions. In such cases the TMDL is often expressed as a percent reduction in total loading based on source quantification results and an evaluation of load reduction potential (**Figure 4-1**). The degree by which existing conditions exceed desired target values can also be used to justify a percent reduction value for a TMDL.

Even if the TMDL is preferably expressed using a time period other than daily, an allowable daily loading rate will also be calculated to meet specific requirements of the federal Clean Water Act. Where this occurs, TMDL implementation and the development of allocations will still be based on the preferred time period, as noted above.

4.4 Determining Pollutant Allocations

Once the allowable load (the TMDL) is determined, that total must be divided among the contributing sources. In addition to basic technical and environmental analysis, DEQ also considers economic and social costs and benefits when developing allocations. The allocations are often determined by quantifying feasible and achievable load reductions through application of a variety of best management practices and other reasonable conservation practices.

Under the current regulatory framework (40CFR 130.2) for developing TMDLs, flexibility is allowed in allocations in that “TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure.” Allocations are typically expressed as a number, a percent reduction (from the current load), or as a surrogate measure (e.g., a percent increase in canopy density for temperature TMDLs).

Figure 4-2 illustrates how TMDLs are allocated to different sources using WLAs for point sources and LAs for natural and nonpoint sources. Although some flexibility in allocations is possible, the sum of all allocations must meet the water quality standards in all segments of the waterbody.

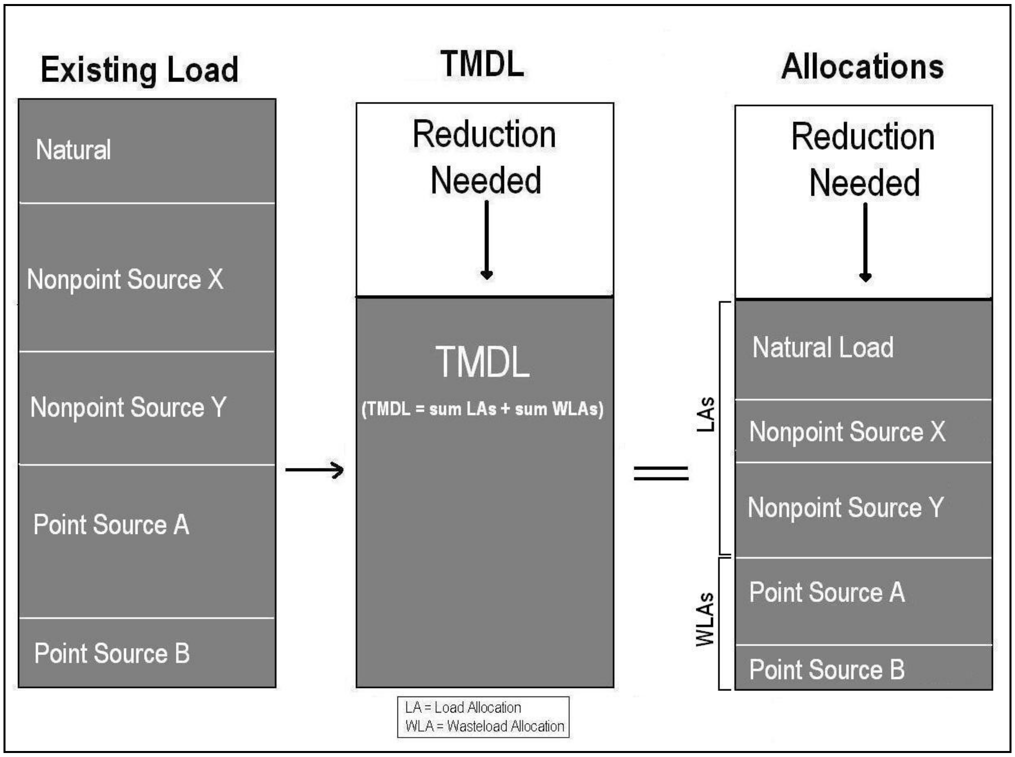

Figure 4-2. Schematic Diagram of a TMDL and its Allocations

Incorporating an MOS is required when developing TMDLs. The MOS accounts for the uncertainty between pollutant loading and water quality and is intended to ensure that load reductions and allocations are sufficient to support beneficial uses. The MOS may be applied implicitly by using conservative assumptions in the TMDL development process or explicitly by setting aside a portion of the allowable loading (U.S. Environmental Protection Agency, 1999).

5.0 Sediment TMDL Development

This portion of the document focuses on sediment as an identified cause of water quality impairments in the Tobacco TMDL Planning Area (TPA). It includes: 1) the mechanisms by which sediment can impair beneficial uses, 2) the specific stream segments of concern, 3) the presently available data pertaining to sediment impairment characterization in the watershed, including target development and a comparison of existing water quality to targets, 4) quantification of the various contributing sources of sediment based on recent studies, and 5) identification of and justification for the sediment TMDLs and the TMDL allocations.

5.1 Mechanism of Effects of Excess Sediment on Beneficial Uses

Sediment is a naturally occurring component of healthy and stable stream and lake ecosystems. Regular flooding allows sediment deposition to build floodplain soils and point bars, and it prevents excess scour of the stream channel. Riparian vegetation and natural instream barriers such as large woody debris, beaver dams, or overhanging vegetation help trap sediment and build channel and floodplain features. When these barriers are absent or excessive sediment loading enters the system from increased bank erosion or other sources, it may alter channel form and function and affect fish and other aquatic life by increasing turbidity and causing excess sediment to accumulate in critical aquatic habitat areas not naturally characterized by high levels of fine sediment.

More specifically, sediment may block light and cause a decline in primary production, and it may also interfere with fish and macroinvertebrate survival and reproduction. Fine sediment deposition reduces availability of suitable spawning habitat for salmonid fishes and can smother eggs or hatchlings. Effects from excess sediment are not limited to suspended or fine sediment; an accumulation of larger sediment (e.g., cobbles) can fill pools, reduce the percentage of desirable particle sizes for fish spawning, and cause channel overwidening (which may lead to additional sediment loading and/or increased temperatures). This larger sediment can also reduce or eliminate flow in some stream reaches where sediment aggrades within the channel, causing flow to go subsurface (May and Lee, 2004). Although fish and aquatic life are typically the most sensitive beneficial uses regarding sediment, excess sediment may also affect other uses. For instance, high concentrations of suspended sediment in streams can also cause water to appear murky and discolored, negatively impacting recreational use, and excessive sediment can increase filtration costs for water treatment facilities that provide safe drinking water.

5.2 Stream Segments of Concern

A total of seven waterbody segments in the Tobacco TPA appeared on the 2010 Montana 303(d) List due to sediment impairments (**Table 5-1**). These include: Deep Creek, Edna Creek, Fortine Creek, Lime Creek, Swamp Creek, Therriault Creek and the Tobacco River. As shown in **Table 5-1**, many of the waterbodies with sediment impairments are also listed for habitat and flow alterations, which are non-pollutant forms of pollution frequently associated with sediment impairment. TMDLs are limited to pollutants, but implementation of land, soil, and water conservation practices to reduce pollutant loading will inherently address some non-pollutant impairments.

Sinclair Creek (MT76D004_091 and MT76D004_092), a tributary to the Tobacco River, was not on the 303(d) list but was identified as having insufficient data to assess beneficial use support and was also evaluated as part of TMDL development based on stakeholder concerns.

Table 5-1. Waterbody Segments in the Tobacco TPA with Sediment Listings and Possible Sediment-related Listings on the 2010 303(d) List

Stream Segment	Waterbody ID	Sediment Pollutant Listing	Non-Pollutant Causes of Impairment Potentially Linked to Sediment Impairment
Deep Creek, headwaters to mouth (Fortine Creek)	MT76D004_080	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers
Edna Creek, headwaters to mouth (Fortine Creek)	MT76D004_030	Sedimentation/ Siltation	
Fortine Creek, headwaters to mouth (Grave Creek)	MT76D004_020	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers & flow alterations
Lime Creek, headwaters to mouth (Fortine Creek)	MT76D004_050	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers
Swamp Creek, headwaters to mouth (Fortine Creek)	MT76D004_040	Sedimentation/ Siltation	Alteration in streamside or littoral vegetative covers & flow alterations
Therriault Creek, headwaters to mouth (Tobacco River)	MT76D004_070	Sedimentation/ Siltation	
Tobacco River, confluence of Grave Creek & Fortine Creek to mouth (Lake Koocanusa)	MT76D004_010	Sedimentation/ Siltation	Physical substrate habitat alterations

5.3 Information Sources and Assessment Methods to Characterize Sediment Conditions

For TMDL development, information sources and assessment methods fall within two general categories. The first category, discussed within this section, is focused on characterizing overall stream health with focus on sediment and related water quality conditions. The second category, discussed within **Section 5.6**, is focused on quantifying sources of sediment loading within the watershed.

5.3.1 Summary of Information Sources

To characterize sediment conditions for TMDL development purposes, a sediment data compilation was completed and additional monitoring was performed during 2008. The below listed data sources represent the primary information used to characterize water quality and/or develop TMDL targets.

- DEQ Assessment Files
- DEQ 2008 Sediment and Habitat Assessments
- Relevant Local and Regional Reference Data
- GIS data layers and publications regarding historical land usage, channel stability, and sediment conditions

5.3.2 DEQ Assessment Files

The DEQ assessment files contain information used to make the existing sediment impairment determinations. The files include a summary of physical, biological, and habitat data collected by DEQ on most waterbodies between 2003 and 2008 (denoted as “DEQ Monitoring Sites” in **Figure 5-1**) as well as other historical information collected or obtained by DEQ. The most common quantitative data that will be incorporated from the assessment files are pebble counts and macroinvertebrate index scores. The files also include information on sediment water quality characterization and potentially significant sources of sediment, as well as information on non-pollutant impairment determinations and associated rationale.

5.3.3 DEQ's 2008 Sediment and Habitat Assessments

Field measurements of channel morphology and riparian and instream habitat parameters were collected in 2008 from 18 reaches on 8 waterbodies to aid in TMDL development (**Figure 5-1**). To aid in the characterization of bank erosion, an additional 14 reaches were assessed in 2008 for bank erosion severity and source identification (**Figure 5-1**). Note that although a sediment TMDL was completed for Grave Creek in 2005, one of the assessed reaches was on Clarence Creek, a tributary to Grave Creek. The site on Clarence Creek was included to help characterize bank erosion and collect additional sediment/habitat data in the Grave Creek watershed using the same protocols as the 2008 assessments performed within the rest of the Tobacco Creek watershed.

Initially, all streams of interest underwent an aerial assessment procedure by which reaches were characterized by four main attributes not linked to human activity: stream order, valley gradient, valley confinement, and ecoregion. These four attributes represent main factors influencing stream morphology, which in turn influences sediment transport and deposition. The next step in the aerial assessment involved identification of near-stream land uses since land management practices can have a significant influence on stream morphology and sediment characteristics. The resulting product was a stratification of streams into reaches that allow for comparisons among those reaches of the same natural morphological characteristics, while also indicating stream reaches where land management practices may further influence stream morphology. The stream stratification, along with field reconnaissance, provided the basis for selecting the above-referenced monitoring reaches. Although ownership is not part of the reach type category, because of the distribution of private and federal land within the watershed, most reach type categories contain predominantly either private or public lands.

Monitoring reaches were chosen with the goal of being representative of various reach characteristics, land use category, and anthropogenic influence. There was a preference toward sampling those reaches where anthropogenic influences would most likely lead to impairment conditions since it is a primary goal of sediment TMDL development to further characterize sediment impairment conditions. Thus, it is not a random sampling design intended to sample stream reaches representing all potential impairment and non-impairment conditions. Instead, it is a targeted sampling design that aims to assess a representative subset of reach types while ensuring that reaches within each [sediment] 303(d) listed waterbody with potential impairment conditions are incorporated into the overall evaluation. Typically, the effects of excess sediment are most apparent in low gradient, unconfined streams larger than 1st order (i.e., having at least one tributary); therefore, this stream type was the focus of the field effort (**Table 5-2**). Although the TMDL development process necessitates this targeted sampling design, it is acknowledged that this approach results in less certainty regarding conditions in 1st order streams and higher gradient reaches, and that conditions within sampled reaches are not necessarily representative of conditions throughout the entire stream.

The field parameters assessed in 2008 include standard measures of stream channel morphology, fine sediment, stream habitat, riparian vegetation, and streambank erosion. Although the sampling areas are frequently referred to as "sites" within this document, to help increase sample sizes and capture variability within assessed streams, they were actually sampling reaches ranging from 500 to 2000 feet (depending on the channel bankfull width) that were broken into five cells. Generally, channel morphology and fine sediment measures were performed in three of the cells, and stream habitat, riparian, and bank erosion measures were performed in all cells. Field parameters are briefly described in **Section 5.4**, and summaries of all field data are contained in the 2008 monitoring summary report (**Appendix D**).

5.3.4 Relevant Local and Regional Reference Data

Regional reference data was derived from Kootenai National Forest (KNF) reference sites and the PACFISH/INFISH Biological Opinion Effectiveness Monitoring Program (PIBO). There is reference data for channel morphology parameters (i.e., width/depth and entrenchment) for 151 sites assessed within all districts of the KNF between 1992 and 1999 and then a more extensive reference dataset (i.e., channel morphology, fine sediment, and habitat measures) for 77 sites within the Libby District collected between 1995 and 2004. The Libby District lies entirely within the Northern Rockies (Level III) and Salish Mountains (Level IV). The PIBO reference dataset (http://www.fs.fed.us/biology/fishecology/emp/) includes USFS and BLM sites throughout the Pacific Northwest, but to increase the comparability of the data to conditions in the Tobacco River watershed, only data collected within the Canadian Rockies and Northern Rockies ecoregions were evaluated. This includes data from the 67 sites in the Canadian Rockies and 31 sites in the Northern Rockies collected between 2001 and 2009.

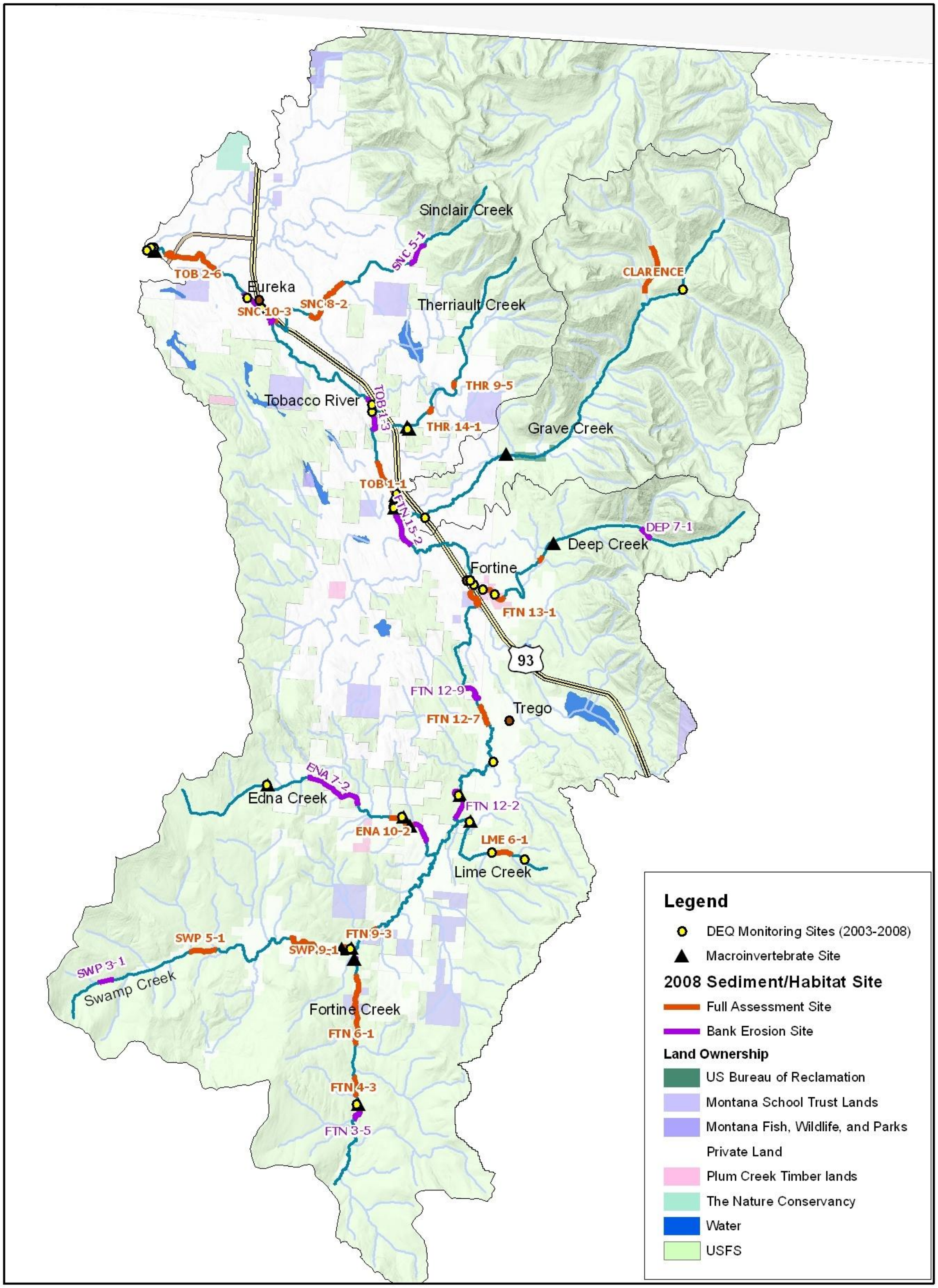

Figure 5-1. Reaches Assessed by DEQ in 2008 and Historical DEQ Monitoring Sites

Table 5-2. Stratified Reach Types and Sampling Site Representativeness within the Tobacco TPA

Level III Ecoregion	Valley Gradient	Strahler Stream Order	Confine-ment*	Reach Type	Number of Reaches	Number of Full Monitoring Sites	*Number of Bank Erosion/ BEHI Monitoring Sites*
Canadian Rockies	0 - 2%	2	U	CR-0-2-U	17	4	
		3	U	CR-0-3-U	1		
		4	C	CR-0-4-C	1		
			U	CR-0-4-U	9		
	2 - 4%	1	U	CR-2-1-U	3		
		2	C	CR-2-2-C	1		
			U	CR-2-2-U	7		
		3	U	CR-2-3-U	6	1	
		4	U	CR-2-4-U	2		
	4 - 10%	1	U	CR-4-1-U	6		
		2	C	CR-4-2-C	3		
			U	CR-4-2-U	6	1 (Clarence)	2
		3	U	CR-4-3-U	5	1	
		4	U	CR-4-4-U	1		
	> 10%	1	C	CR-10-1-C	2		
			U	CR-10-1-U	6		
		2	U	CR-10-2-U	2		
Northern Rockies	0 - 2%	1	U	NR-0-1-U	1		
		2	U	NR-0-2-U	4		
		3	U	NR-0-3-U	24	3	2
		4	U	NR-0-4-U	32	3	4
		5	U	NR-0-5-U	11	2	2
	2 - 4%	1	U	NR-2-1-U	3		
		2	U	NR-2-2-U	5		1
		3	U	NR-2-3-U	12	1	1
	4 - 10%	1	U	NR-4-1-U	3		
		2	U	NR-4-2-U	7		2
		3	U	NR-4-3-U	4	2	
	> 10%	1	U	NR-10-1-U	2		
Totals:					**187**	**18**	**14**

*U = Unconfined, C = Confined per DEQ's stratification methodology

5.4 Water Quality Targets and Comparison to Existing Conditions

The concept of water quality targets was presented in **Section 4.1**, but this section provides the rationale for each sediment-related target parameter, discusses the basis of the target values, and then presents a comparison of those values to available data for the stream segments of concern in the Tobacco River watershed (**Table 5-1**). Although placement onto the 303(d) list indicates impaired water quality, a comparison of water quality targets to existing data helps define the level of impairment and establishes a benchmark to help evaluate the effectiveness of restoration efforts.

In developing targets, natural variation throughout the river continuum must be considered. As discussed in more detail in **Section 3** and **Appendix C**, DEQ uses the reference condition to gage natural variability and assess the effects of pollutants with narrative standards, such as sediment. The preferred approach to establishing the reference condition is utilizing reference site data, but modeling, professional judgment, and literature values may also be used. DEQ defines "reference" as the condition of a waterbody capable of supporting its present and future beneficial uses when all reasonable land, soil, and water conservation practices have been applied. In other words, reference condition reflects a waterbody's greatest potential for water quality given historic and current land use activities. Waterbodies used to determine reference conditions are not necessarily pristine. The reference condition approach is intended to accommodate natural variations due to climate, bedrock, soils, hydrology and other natural physiochemical differences yet allow differentiation between natural conditions and widespread or significant alterations of biology, chemistry or hydrogeomorphology due to human activity.

The basis for the value for each water quality target varies depending on the availability of reference data and sampling method comparability to the 2008 DEQ data. As discussed in **Appendix C**, there are several statistical approaches DEQ uses for target development; they include using percentiles of reference data or of the entire sample dataset, if reference data are limited. For example, if low values are desired, the sampled streams are assumed to be severely degraded, and there is a high degree of confidence in the reference data, the 75th percentile of the reference dataset or the 25th percentile of the sample dataset (if reference data are not available) is typically used. However, percentiles may be used differently depending on whether a high or low value is desirable, the representativeness and range of variability of the data, the severity of human disturbance to streams within the watershed, and size of the dataset. For each target, descriptive statistics were generated relative to any available reference data (e.g., KNF, Libby District, or PIBO) as well as for the entire sample dataset. The preferred approach for setting target values is to use reference data, where preference is given towards the most protective reference dataset. Additionally, the target value for some parameters may apply to all streams in the Tobacco River watershed, whereas others may be stratified by bankfull width, reach type characteristics (i.e., ecoregion, gradient, stream order, and/or confinement), or by Rosgen stream type if those factors are determined be important drivers for certain target parameters. Although the basis for target values may differ by parameter, the goal is to develop values that incorporate an implicit margin of safety (MOS) and are achievable. The MOS is discussed in additional detail in **Section 5.8.2**.

5.4.1 Water Quality Targets

The sediment water quality targets for the Tobacco River watershed are summarized in **Table 5-3** and described in detail in the sections that follow. Listed in order of preference, sediment-related targets for the Tobacco River watershed are based on a combination of reference data from the KNF, reference data from the Canadian Rockies and Northern Rockies portion of the PIBO dataset, and sample data from the DEQ 2008 sampling effort. **Attachment C** provides a summary of the DEQ 2008 sample data and a description of associated field protocols.

Consistent with EPA guidance for sediment TMDLs (U.S. Environmental Protection Agency, 1999), water quality targets for the Tobacco watershed are comprised of a combination of measurements of instream siltation, channel form, biological health, and habitat characteristics that contribute to loading, storage, and transport of sediment, or that demonstrate those effects. Water quality targets most closely linked to sediment accumulation or sediment-related effects to aquatic life habitat are given the most weight (i.e., fine sediment and biological indices). Target parameters and values are based on the current best available information, but they will be assessed during future TMDL reviews for their applicability and may be modified if new information provides a better understanding of reference conditions or if assessment metrics or field protocols are modified. For all water quality targets, future surveys should document stable (if meeting criterion) or improving trends. The exceedance of one or more target values does not necessarily equate to a determination that the information supports impairment; the degree to which one or more targets are exceeded are taken into account (as well as the current 303(d) listing status), and the combination of target analysis, qualitative observations, and sound, scientific professional judgment is crucial when assessing stream condition. Site-specific conditions such as recent wildfires, natural conditions, and flow alterations within a watershed may warrant the selection of unique indicator values that differ slightly from those presented below, or special interpretation of the data relative to the sediment target values.

Table 5-3. Sediment Targets for the Tobacco TPA

Parameter Type	Target Description	Criterion
Fine Sediment	Percentage of fine surface sediment in riffles via pebble count (reach average)	6mm ≤ 15% 2mm ≤ 8%
	Percentage of fine surface sediment < 6mm in riffles and pool tails via grid toss (reach average)	≤ 8%
Channel Form and Stability	Bankfull width/depth ratio (reach median)	B & C stream types with bankfull width < 30ft: ≤ 21 B & C stream types with bankfull width > 30ft: ≤ 35 E stream types: ≤ 8
	Entrenchment ratio (reach median)	B stream types: > 1.4
		C stream types: > 2.7
		E stream types: > 2.3
Instream Habitat	Residual pool depth (reach average)	< 20' bankfull width : ≥ 0.8 (ft)
		20' - 35' bankfull width : ≥ 1.2 (ft)
		> 35' bankfull width : ≥ 1.6 (ft)
	Pools/mile	< 20' bankfull width : ≥ 75
		20' - 35' bankfull width: ≥ 42
		> 35' bankfull width : ≥ 31
		Tobacco River: : ≥ 12
	LWD/mile	< 20' bankfull width : ≥ 359
		20' - 35' bankfull width : ≥ 242
		> 35' bankfull width : ≥ 104
Riparian Health	Percent of streambank with understory shrub cover (reach average)	≥ 57% understory shrub cover
Sediment Source	Significant and controllable sediment sources	Identification of significant and controllable anthropogenic sediment sources throughout the watershed
Biological Indices	Macroinvertebrate bioassessment impairment thresholds	Mountain MMI ≥ 63
		O/E ≥ 0.80

5.4.1.1 Fine Sediment

The percent of surface fines less than 6 mm and 2 mm is a measurement of the fine sediment on the surface of a streambed and is directly linked to the support of the coldwater fish and aquatic life beneficial uses. Increasing concentrations of surficial fine sediment can negatively affect salmonid growth and survival, clog spawning redds, and smother fish eggs by limiting oxygen availability (Irving and Bjorn, 1984; Weaver and Fraley, 1991; Shepard, et al., 1984; Suttle, et al., 2004). Excess fine sediment can also decrease macroinvertebrate abundance and taxa richness (Mebane, 2001; Zweig and Rabeni, 2001). Because similar concentrations of sediment can cause different degrees of impairment to different species, and even age classes within a species, and because the particle size defined as "fine" is variable and some assessment methods measure surficial sediment while others measure also include subsurface fine sediment, literature values for harmful fine sediment thresholds are highly variable. Some studies of salmonid and macroinvertebrate survival found an inverse relationship between fine sediment and survival (Suttle, et al., 2004) whereas other studies have concluded the most harmful percentage falls within 10 to 40 percent fine sediment (Bjorn and Reiser, 1991; Mebane, 2001; Relyea, et al., 2000). Bryce, et al. (2010) evaluated the effect of surficial fine sediment (via reach transect pebble counts) on fish and macroinvertebrates and found that the minimum effect level for sediment < 2mm is 13% for fish and 10% for macroinvertebrates. Literature values are taken into consideration during fine sediment target development, but because increasing concentrations of fine sediment are known to be harmful to aquatic life, targets are developed using a conservative statistical approach consistent with **Appendix C**, and consistent with Montana's water quality standard for sediment as described in **Section 3.2.1**.

<u>Ecoregion Considerations</u>
Because geology and soils can be significant differentiating factors between ecoregions, fine sediment targets were initially evaluated within the context of the Level III and IV ecoregions within the Tobacco TPA. Most sediment-listed waterbodies in the Tobacco TPA are in the Northern Rockies Level III ecoregion and largely within the Salish Mountain Level IV ecoregion. The remainder of sediment-listed or evaluated streams in the TPA (i.e., Therriault, Grave, Deep, and Sinclair creeks) originate in the Canadian Rockies Level III ecoregion and Western Canadian Rockies Level IV ecoregion but flow into the Northern Rockies. Fine sediment values are similar between these ecoregions for pebble counts and grid tosses within the 2008 DEQ Tobacco sample dataset and for grid tosses within the PIBO reference dataset. Additionally, the interquartile range and median of the median particle size (D50) in PIBO streams were similar between the Level IV ecoregions, which are at a finer scale than Level III. Therefore, achievable fine sediment conditions are assumed to be similar throughout the watershed and Tobacco TPA fine sediment targets are not broken out by ecoregion.

Riffle Substrate Percent Fine Sediment < 6mm and < 2mm via Pebble Count
Surface fine sediment measured in riffles by the modified (Wolman, 1954) pebble count indicates the particle size distribution across the channel width and is an indicator of aquatic habitat condition that can point to excessive sediment loading. Pebble counts in 2008 were performed in three riffles per sampling reach for a total of at least 300 particles. For DEQ data collected in 2003, pebble counts at each reach were performed from bankfull to bankfull in a single representative riffle for a total of at least 100 particles.

Pebble count reference data are available from the Libby District of the KNF. Pebble counts for the Libby District were a composite of riffles and pools, which can increase the fine sediment percentage relative to a riffle-only pebble count; in a review of the field forms, pools did not typically increase the overall percentage of fines, indicating results between the Libby District and Tobacco sample dataset are comparable. The target for riffle substrate percent fine sediment is based on the 75th percentile of the KNF Libby District reference dataset and is set at less than or equal to 15% < 6mm and 8% < 2mm. The target for sediment < 6mm is similar to that set in other TMDLs for the Northern Rockies (e.g., Lower Clark Fork: 10%, Grave Creek and Prospect Creek: 15%, Yaak: 20%), and the target for < 2mm is close to the macroinvertebrate minimum effect level of 10% found by Bryce et al. (2010). Rosgen E channels tend to have a higher percentage of fine sediment than B and C channels (which comprise most of the 2008 DEQ assessment reaches), but the KNF Libby District dataset only contains two E channel sites. The percent fines values at the reference sites are 1% and 16% for < 6mm and 0% and 8% < 2mm. Therefore, the 15% < 6mm and 8%< 2mm targets will be applied to all channel types but because of the general trend for E channels and the small samples size of reference E channels, the target will carry less weight for E channels. Target values should be compared to the reach average value from pebble counts.

Percent Fine Sediment < 6mm in Riffle and Pool Tails via Grid Toss
Grid toss measurements in riffles and pool tails are an alternative measure to pebble counts that assess the level of fine sediment accumulation in macroinvertebrate habitat and potential fish spawning sites. A 49-point grid toss (Kramer, et al., 1993) was used to estimate the percent surface fine sediment < 6mm in riffles and pool tails in the Tobacco River watershed, and three tosses, or 147 points, were performed and then averaged for each assessed riffle and for the spawning gravel substrate portion of each assessed pool tail.

Grid toss reference data are contained in the PIBO dataset but only for pool tails. The 75th percentile of the PIBO reference data for pool tails is 18% and the median is 8%. In the 2008 Tobacco sample dataset, pool tail grid toss values were very low with percentiles as follows: 25^{th}= 1, median = 3%, and 75^{th} = 10%. This information suggests a potential variation in assessment methods between PIBO and the DEQ pool grid toss method. This is further supported by the fact that data sets used for setting pool grid toss targets in other TMDL watersheds have resulted in values closer to the median of the PIBO data (8%) and the 75^{th} percentile of the Tobacco dataset (10%). Therefore, the grid toss target for fine sediment < 6mm is < 8% for pool tails consistent with the PIBO median values, the Tobacco dataset, and results from other TMDL projects.

In the 2008 Tobacco sample dataset, riffle grid toss values were also very low with percentiles as follows: 25^{th}= 1, median = 3%, and 75^{th} = 8%. Because there is no reference data to use as a basis for the riffle grid toss target, the 75^{th} percentile of pool tail grid toss values in the sample dataset compared favorably to the median of PIBO reference values, and other sample dataset percentiles (25^{th} and median) are well below literature values, the riffle grid toss target is based on the 75^{th} percentile of the sample dataset to help identify those reaches that have relatively high levels of fines. Therefore, the grid toss target for fine sediment < 6mm is 8% for riffles.

Using the same logic as applied for the pebble count targets, the grid toss target will apply to all channel types but will hold less weight for E channels. Similar to the pebble count target for < 6mm, the riffle and pool tail grid toss targets are similar to values set in several other TMDLs within the Northern Rockies (St. Regis, Prospect Creek, and Grave Creek TMDLs (i.e., values ranged from 8-10%)). For each habitat area, the target should be assessed based on the reach average grid toss value.

5.4.1.2 Channel Form and Stability

Width/Depth Ratio and Entrenchment Ratio
The width/depth ratio and the entrenchment ratio are dimensionless values representing fundamental aspects of channel morphology. Each provides a measure of channel stability, as well as an indication of the ability of a stream to transport and naturally sort sediment into a heterogeneous composition of fish habitat features (i.e., riffles, pools, and near bank zones). Changes in both the width/depth ratio and entrenchment ratio can be used as indicators of change in the relative balance between the sediment load and the transport capacity of the stream channel. As the width/depth ratio increases, streams become wider and shallower, suggesting an excess coarse sediment load (MacDonald, et al., 1991). As sediment accumulates, the depth of the stream channel decreases, which is compensated for by an increase in-channel width as the stream attempts to regain a balance between sediment load and transport capacity. Conversely, a decrease in the entrenchment ratio signifies a loss of access to the floodplain. Low entrenchment ratios signify that stream energy is concentrated in-channel during flood

events versus having energy dissipation on the floodplain. Accelerated bank erosion and an increased sediment supply often accompany an increase in the width/depth ratio and/or a decrease in the entrenchment ratio (Rosgen, 1996; Knighton, 1998; Rowe, et al., 2003). Width/depth and entrenchment ratios were calculated for each 2008 assessment reach based on 5 riffle cross section measurements.

Width/Depth Ratio Target Development

There is reference riffle width/ratio data for the KNF, KNF Libby District, and PIBO, but because the Libby District data is a subset of the KNF dataset, only the KNF and PIBO reference data were reviewed as potential targets. The 2008 Tobacco dataset is primarily comprised of B and C channels, and although on average B channels tend to have a smaller width/depth ratio than C channels (Rosgen, 1996), the ratio can vary quite a bit between small and larger streams. Because the waterbodies in the 2008 Tobacco dataset range in bankfull width (BFW) from 13 to 96 feet (median=23ft, 75^{th}=34ft) and the reaches evaluated in 2008 were all estimated to have the potential to be a Rosgen B and/or C channel, target values are combined for B and C channels and expressed by BFW. Both reference datasets have BFW values that range from approximately 5ft to 50ft, but the PIBO dataset has a much greater number of larger streams (KNF: median=15ft, 75^{th}=21ft; PIBO: median=30ft, 75^{th}=39ft).

The KNF value for smaller streams (bankfull width < 30 ft) is preferred over the PIBO data because of the KNF data represents a more local regional reference data set, the KNF data has a significantly higher sample size of 94 versus the 44 for the PIBO data set, the values are consistent with sediment targets for similar stream sizes in other DEQ sediment TMDL documents, and because the KNF data provides the appropriate level of water quality protection based on results and observations regarding achievable width to depth ratio potential for the assessed streams. Unfortunately the KNF reference sample size for larger streams (bankfull width > 30) is only 7, whereas the equivalent PIBO sample size is 47. Therefore, the width/depth ratio target for B and C streams with a BFW less than 30 feet will be ≤ 21 based on the 75^{th} percentile of the KNF reference data and the target for B and C streams with a BFW equal to or greater than 30 feet will be ≤ 35 based on the 75^{th} percentile of PIBO reference (**bolded** in **Table 5-4**). The streams in the PIBO dataset are not broken out by Rosgen channel type but based on a review of reference-based width/depth ratio targets ranging from 29-33 for large B/C channels in the St. Regis, Grave Creek, and Prospect Creek TMDLs, 35 is an appropriate target for larger B/C channels within the Tobacco TPA. Lime Creek was the only stream identified as a different channel type (i.e., E), and although the sample size is smaller than desired, the target for E channels will be ≤ 8 based on the 75^{th} percentile of E channel in the KNF dataset because the PIBO dataset is not broken out by stream type. The target width/depth ratios are set at less than or equal to those values indicated by channel type and BFW in **Table 5-4**.

Table 5-4. The 75^{th} Percentiles of Reference Data used for Width/Depth Ratio Target Development

Data Source	Category	Sample Size	75^{th} Percentile W/D
KNF Reference	B/C channels BFW < 30’	94	**21**
KNF Reference	B/C channels BFW > 30’	7	29
KNF Reference	E channels	3	**8**
PIBO Reference	BFW < 30’	44	27
PIBO Reference	BFW > 30’	47	**35**

Entrenchment Ratio Target Development

Because higher values are more desirable for entrenchment ratio, the target value for entrenchment ratio is set at greater than or equal to the 25^{th} percentile of the KNF reference data (**Table 5-5**). When comparing assessment results to target values, more weight will be given to those values that fail to satisfy the identified target and fail to meet the minimum value associated with literature values for Rosgen stream type (i.e., B=1.4-2.2 ± 0.2, C & E 2.2 ± 0.2) (Rosgen, 1996) and reaches with multiple potential channel types will be evaluated using the lowest target value (e.g., Target for B3/C3 = 1.4).

Table 5-5. Entrenchment Targets for the Tobacco TPA Based on the 25th Percentile of KNF Reference Data

Rosgen Stream Type	Sample Size	25th Percentile of KNF Reference Data
B	93	1.4
C	8	2.7
E	3	2.3

5.4.1.3 Instream Habitat Measures

For all instream habitat measures (i.e., residual pool depth, pool frequency, and large woody debris frequency), there is available reference data from the Libby District of the KNF and from PIBO. All of the instream habitat measures are important indicators of sediment input and movement as well as fish and aquatic life support, but they may be given less weight in the target evaluation if they do not seem to be directly related to sediment impacts. The use of instream habitat measures in evaluating or characterizing impairment needs to be considered from the perspective of whether these measures are linked to fine, coarse, or total sediment loading.

Residual Pool Depth

Residual pool depth, defined as the difference between the maximum depth and the tail crest depth, is a discharge-independent measure of pool depth and an indicator of the quality of pool habitat. Deep pools are important resting and hiding habitat for fish, and provide refugia during temperature extremes and high flow periods (Nielson, et al., 1994; Bonneau and Scarnecchia, 1998; Baigun, 2003). Similar to channel morphology measurements, residual pool depth integrates the effects of several stressors; pool depth can be decreased as a result of filling with excess sediment (fine or coarse), a reduction in-channel obstructions (such as large woody debris), and changes in-channel form and stability (Bauer and Ralph, 1999). A reduction in pool depth from channel aggradation may not only alter surface flow during the critical low flow periods, but may also impair fish condition by altering habitat, food availability, and productivity (May and Lee, 2004; Sullivan and Watzin, 2010). Residual pool depth is typically greater in larger systems.

Although the residual pool depth measure is similar between DEQ’s method and both reference methods, the definition of a pool can vary between the methods. Out of both available reference datasets, the core definition of pools for the PIBO protocol is closer to the definition used for the DEQ 2008 Tobacco sample dataset where pools were defined as depressions in the streambed bounded by a “head crest” at the upstream end and “tail crest” at the downstream end with a maximum depth that is at least 1.5 times the pool tail depth (Kershner, et al., 2004). The Libby District dataset defines pools as slack water areas occupying at least one-third of the bankfull channel with a scour feature and hydraulic control.

DEQ further defined pools as large, medium or small depending on the width of the pool in relation to the stream’s bankfull width, whereas the PIBO protocol only counts pools greater than half the wetted channel width. In comparison to the PIBO dataset, the DEQ dataset could have a higher pool frequency and more pools with a smaller residual pool depth since the DEQ protocol has no minimum pool width requirement. In comparison to the Libby dataset, the DEQ dataset could have a lower pool frequency since some slack water areas in the Libby District dataset might not meet the head crest to tail crest ratio requirement used by DEQ.

Based on the differences in protocol between the Libby District and Tobacco sample datasets, and the median of the Tobacco sample dataset comparing favorably to the median and 25th percentiles of both reference datasets (indicating high residual pool depth values in the Tobacco TPA), the target for residual pool depth is greater than or equal to the 25th percentile of PIBO reference data. Although none of the channels in the PIBO reference dataset are as wide as the Tobacco River and there are no target values for other similar sized systems in northwestern Montana, residual pool depth tends to increase with channel size and 1.6 feet should be a reasonable target value for the Tobacco River. The target values are shown in bold in **Table 5-6** and expressed by channel BFW, and they should be assessed based on the reach average residual pool depth value. Because residual pool depths can indicate if excess sediment is limiting pool habitat, this parameter will be particularly valuable for future trend analysis using the data collected in 2008 as a baseline. Future monitoring should document an improving trend (i.e., deeper pools) at sites which fail to meet the target criteria, while a stable trend should be documented at established monitoring sites that are currently meeting the target criteria.

Table 5-6. Percentiles of Reference Data and 2008 Tobacco Sample Data for Residual Pool Depth (ft) used for Target Development

Category	Libby Reference			PIBO Reference			DEQ Sample Data		
	n	Median	25th	n	Median	25th	n	Median	75th
< 20' BFW	57	0.8	0.6	19	1.1	**0.8**	5	1.2	1.5
20-35' BFW	18	1.4	1.2	42	1.2	**0.9**	10	1.2	1.6
> 35' BFW (including Tobacco River)	0	--	--	37	1.9	**1.6**	3	1.9	2.1

Targets are shown in **bold**.

Pool Frequency

Pool frequency is another indicator of sediment loading that relates to changes in-channel geometry and is an important component of a stream's ability to support the fishery beneficial use for many of the same reasons associated with the residual pool depth discussed above and also because it can be a major driver of fish density (Muhlfeld and Bennett, 2001; Muhlfeld, et al., 2001). Sediment may limit pool habitat by filling in pools with fines. Alternatively, aggradation of larger particles may exceed the stream's capacity to scour pools, thereby reducing the prevalence of this critical habitat feature. Pool frequency generally decreases as stream size (i.e., watershed area) increases.

Based on the differences in pool definition between the Libby District reference dataset and the 2008 Tobacco sample dataset (described above), the target for pool frequency is based on the PIBO reference dataset. Because the median pool frequency values in PIBO reference dataset compare favorably to both the 25th percentile of the Libby District reference data and the median of the 2008 Tobacco sample data (**Table 5-7**), the pool frequency target is greater than or equal to the median of the PIBO dataset (**bold** in **Table 5-7**). The pool frequency targets are similar to the INFISH Riparian Management Objectives (U.S. Department of Agriculture, Forest Service, 1995a) as well as reference data from the Swan River and Grave Creek watersheds (Montana Department of Environmental Quality, 2005) (**Table 5-8**). Pools per mile should be calculated based the number of measured pools per reach and then scaled up to give a frequency per mile.

Because pool frequency tends to decline as stream size increases and the PIBO dataset only includes streams with a BFW up to 50 feet, 31 pools/mile is likely too high of a target for the Tobacco River. The target for the C channel reaches of lower Grave Creek in the Grave Creek TMDL (Montana Department of Environmental Quality, 2005) is 12 pools/mile based on an internal reference reach, which is less than the 25th percentile of streams in the PIBO dataset (i.e., BFW = 35 – 50 ft), and will be applied as the target for the Tobacco River. Both reaches assessed in 2008 exceeded this value, indicating it is an achievable target, but it may be modified in the future as more relevant reference data are collected.

Table 5-7. Percentiles of Reference Data and 2008 Tobacco Sample Data for Pool Frequency (pools/mile) used for Pool Frequency Target Development

Category	Libby Reference			PIBO Reference			DEQ Sample Data		
	n	Median	25th	n	Median	25th	n	Median	75th
< 20’ BFW	57	114	81	19	**75**	53	5	84	85
20-35’ BFW	18	53	38	42	**42**	30	10	71	90
> 35’ BFW	0	--	--	37	**31**	19	3	32	48
Tobacco River	Target value = **12** pools/mile based on Grave Creek reference reach								

Targets are shown in **bold**

Table 5-8. INFISH and Reference Pool Frequency Values by Channel Bankfull Width (BFW)

Comparative Data Source	Smaller Stream Values (pools/mile)	Larger Stream Values (pools/mile)
Swan River tributary reference	19-35’ BFW: 25th = 70	35-45’ BFW: 25th = 29
Grave Creek reference	10-20’ BFW: 73-118 20-35’ BFW: 47-66	40-60’ BFW: 12
INFISH	< 20’ BFW: 96-56 25’ BFW: 47	50’ BFW: 26

Large Woody Debris

Large woody debris (LWD) is a critical component of stream ecosystems, providing habitat complexity, quality pool habitat, cover, and long-term nutrient inputs. LWD also constitutes a primary influence on stream function, including sediment and organic material transport, channel form, bar formation and stabilization, and flow dynamics (Bilby and Ward, 1989). LWD numbers generally are greater in smaller, low order streams. The application of a LWD target will carry very little weight for sediment impairment verification purposes, but may have significant implications as an indicator of a non-pollutant type of impairment.

For DEQ sampling in 2008, wood was counted as LWD if it was greater than 9 feet long or two-thirds of the wetted stream width, and 4 inches in diameter at the small end (Overton, et al., 1997). The LWD count for both available reference datasets was compiled using a different definition of LWD than the 2008 DEQ sample dataset; if measurements were conducted within the same reach, the Libby District LWD count would likely be less than the DEQ LWD count because the protocol only counted wood if it was larger than 6 inches in diameter and longer than the BFW, and the PIBO LWD count would likely be greater because it includes pieces 3 feet long and 4 inches in diameter. For streams with a BFW greater than 35 feet, the DEQ sample dataset median was much less than the 25th percentile of the PIBO reference data, but for other channel widths, the median fell in the middle of the 25th percentile and median of the PIBO data and was close to the median of the Libby District reference data (**Table 5-9**). Because the protocol for both reference datasets differs from the DEQ protocol and the Libby District data is the preferred reference data, the LWD target is greater than or equal to the median of the Libby District dataset (**bolded** in **Table 5-9**). For channels with a BFW greater than 35 feet, the 25th percentile of the PIBO dataset was considered but determined to be too high relative to the 2008 sample dataset. Reference data from the Swan River watershed for streams with a bankfull width had a 25th percentile of

104 LWD/mile and a 75th percentile of 210 LWD/mile (Montana Department of Environmental Quality, 2004). The 25th percentile of reference data for streams greater than 35 feet in the Swan River watershed closely corresponds to the 75th percentile for the DEQ sample dataset, but the 75th percentile of the DEQ dataset may be lower than the Tobacco River's potential because of legacy effects from historic logging. Therefore, the interquartile range from the Swan River reference dataset, which was also applied to large streams in the Grave Creek TMDL (Montana Department of Environmental Quality, 2005), will be applied as the target for streams in the Tobacco TPA with a BFW greater than 35 feet.

Table 5-9. Percentiles of Reference Data and 2008 Tobacco Sample Data for LWD (LWD/mile) used for Target Development

Category	Libby Reference			PIBO Reference			DEQ Sample Data		
	n	Median	25th	n	Median	25th	n	Median	75th
< 20' BFW	57	**359**	183	19	833	272	5	465	533
20-35' BFW	18	**242**	92	42	388	149	10	214	356
> 35' BFW	0	--	--	37	597	295	3	100	103
> 35' BFW (including Tobacco River)	Target value = **104 – 210** LWD/mile based on reference data from the Swan River watershed and Grave Creek TMDL target								

Targets are shown in **bold**

5.4.1.4 Riparian Health

Riparian Understory Shrub Cover

Interactions between the stream channel and the riparian vegetation along the streambanks are a vital component in the support of the beneficial uses of coldwater fish and aquatic life. Riparian vegetation provides organic material used as food by aquatic organisms and supplies LWD that influences sediment storage and channel morphology. Riparian vegetation helps filter sediment from upland runoff, stabilize streambanks, and it can provide shading, cover, and habitat for fish. During DEQ assessments conducted in 2008, ground cover, understory shrub cover and overstory vegetation were cataloged at 10 to 20 foot intervals along the greenline at the bankfull channel margin along both sides of the stream channel for each monitoring reach. The percent of understory shrub cover is of particular interest in valley bottom streams historically dominated by willows and other riparian shrubs. While shrub cover is important for stream health, not all reaches have the potential for dense shrub cover and are instead well armored with rock or have the potential for a dense riparian community of a different composition, such as wetland vegetation or mature pine forest.

At the 2008 assessment sites, there was an average value of 56% understory shrub cover and a median value of 57% understory shrub cover. Based on this median value, a target value of ≥ 57% is established for understory shrub cover in the Tobacco TPA. This target value should be assessed based on the reach average greenline understory shrub cover value. Because not all reaches have the potential for dense shrub cover, for any reaches that do not meet the target value, the greenline assessment results will be more closely examined to evaluate the potential for dense riparian shrub cover and identify if the streambanks in the reach are stabilized instead by rocks, a mature pine forest, and/or wetland vegetation.

5.4.1.5 Sediment Supply and Sources

Anthropogenic Sediment Sources

The presence of anthropogenic sediment sources does not always result in sediment impairment of a beneficial use. When there are no significant identified anthropogenic sources of sediment within the watershed of a 303(d) listed steam, no TMDL will be prepared since Montana's narrative criteria for sediment cannot be exceeded in the absence of human causes. There are no specific target values associated with sediment sources, but the overall extent of human sources will be used to supplement any characterization of impairment conditions. This includes evaluation of human induced and natural sediment sources, along with field observations and watershed scale source assessment information obtained using aerial imagery and GIS data layers. Because sediment transport through a system can take years or decades, and because channel form and stability can influence sediment transport and deposition, any evaluation of anthropogenic sediment impacts must consider both historical sediment loading as well as historical impacts to channel form and stability since the historical impacts still have the potential to contribute toward sediment and/or habitat impairment. Source assessment analysis will be provided by 303(d) listed waterbody in **Section 5.6**, with additional information in **Appendices D**, **E** and **F**.

5.4.1.6 Biological Indices

Macroinvertebrates

Siltation exerts a direct influence on benthic macroinvertebrates assemblages by filling in spaces between gravel and by limiting attachment sites. Macroinvertebrate assemblages respond predictably to siltation with a shift in natural or expected taxa to a prevalence of sediment tolerant taxa over those that require clean gravel substrates. Macroinvertebrate bioassessment scores are an assessment of the macroinvertebrate assemblage at a site, and DEQ uses two bioassessment methodologies to evaluate impairment condition and aquatic life beneficial use support. Aquatic insect assemblages may be altered as a result of different stressors such as nutrients, metals, flow, and temperature, and the biological index values must be considered along with other parameters that are more closely linked to sediment.

The two macroinvertebrate assessment tools used by DEQ are the Multi-Metric Index (MMI) and the Observed/Expected model (O/E). The rationale and methodology for both indices are presented in the DEQ Benthic Macroinvertebrate Standard Operating Procedure (Montana Department of Environmental Quality, Water Quality Planning Bureau, 2006). Unless noted otherwise, macroinvertebrate samples discussed within this document were collected according to DEQ protocols. Samples collected in 2006 were collected by the USFS and were paired samples collected at the same location by two different protocols (i.e., Kick and Surber); although DEQ samples were primarily collected by the Kick method, USFS samples collected by the Surber protocol are presented in the data summaries because they contain macroinvertebrates from multiple riffles and may be more representative of reach conditions.

The MMI is organized based on different bioregions within Montana (i.e., Mountain, Low Valley, and Plains), and the Tobacco River watershed falls exclusively within the Mountain MMI region, for which the macroinvertebrate community shift point that indicates impairment is an MMI score less than 63. This value is established as a sediment target in the Tobacco TPA. The O/E model compares the taxa that are expected at a site under a variety of environmental conditions with the actual taxa that were found when the site was sampled and is expressed as a ratio of the Observed/Expected taxa (O/E value). The O/E community shift point that indicates impairment for all Montana streams is any O/E value < 0.80. Therefore, an O/E score of ≥ 0.80 is established as a sediment target in the Tobacco TPA. For both metrics, an index score greater than the threshold value is desirable, and the result of each sampling event is evaluated separately. Because index scores may be affected by other pollutants or forms of pollution such as habitat disturbance, they will be evaluated in consideration of more direct indicators of excess sediment. Additionally, because the macroinvertebrate sample frequency and spatial coverage is typically low for each watershed and because of the extent of research showing the harm of excess sediment to aquatic life, meeting both biological targets does not necessarily indicate a waterbody is fully supporting its aquatic life beneficial use and measures that indicate an imbalance in sediment supply and/or transport capacity will also be used for TMDL development determinations.

Because the indices evaluate different aspects of the macroinvertebrate community, the index score for a single sample may meet the target value for one metric but not the other. In these situations, the sample size should be evaluated because an inadequate sample size (i.e., < 300 individuals) can affect the index score. If the sample size is adequate, the index score farthest away from the target/community shift point should be given the most weight (Feldman, 2006). For example, if a sample has an MMI score of 66, which is slightly above the target value, and an O/E score of 0.65, which is well below the target value, the O/E score is given more weight, indicating impairment of the macroinvertebrate community. Additionally, the percent burrowing taxa, which tend to be elevated in macroinvertebrate samples impaired by sediment, will also be evaluated for situations where the metrics do not agree.

5.4.2 Existing Condition and Comparison to Water Quality Targets

This section includes a comparison of existing data to water quality targets along with a TMDL development determination for each 303(d) listed waterbody. Note: Data for the reach on Clarence Creek are not presented in this section because it is a review of data for waterbodies on the 303(d) list for sediment as well as for Sinclair Creek. This review is not performed for Grave Creek since the sediment TMDL has already been written for Grave Creek (Montana Department of Environmental Quality, 2005).

5.4.2.1 Deep Creek

Deep Creek (MT76D004_080) is listed for sedimentation/siltation on the 2010 303(d) List. In addition, Deep Creek is also listed for alteration in streamside or littoral vegetative covers, which is a non-pollutant form of pollution commonly linked to sediment impairment. Deep Creek flows 15.4 miles from the headwaters to the confluence of Fortine Creek.

Deep Creek was listed for sediment impairment in 2006 based on heavy sedimentation in pools, bank erosion, accelerated mass wasting, and active channel downcutting and lateral movement attributed to road density in sensitive areas of the watershed, overgrazing of riparian vegetation, and other habitat disturbances associated with land management practices on both public and private lands.

Physical Condition and Sediment Sources

In 2003, DEQ performed a qualitative assessment of Deep Creek at a site near the mouth (**Figure 5-1**). This data was used to support the current 303(d) listing. The information generated from this assessment is summarized below:

The channel is actively downcutting and there is excessive lateral cutting with point bars present on almost all bends. With the exception of near the lumber mill, there is limited woody vegetation, which is likely associated with grazing practices. Much of the reach is heavily overgrazed and the riparian function rating is “not sustainable.” Herbaceous species currently dominate the riparian zone but the potential for regeneration of woody vegetation is high. The substrate is dominated by gravels and sands, and there are heavy sediment deposits in pools, particularly upstream of Highway 93. Spawning habitat is greatly reduced by sediment deposition and there is very little woody debris present. A beaver complex around the timber mill is acting as sediment trap but upstream impacts make sediment load excessive.

File photos showed a degraded riparian condition with grazing to the streambank, very little woody vegetation in the riparian zone, heavy bedload deposition, eroding banks, and an overwidened channel.

In 2008, DEQ performed sediment and habitat assessments at two monitoring sites on Deep Creek (**Figure 5-1**). The uppermost site (DEP 9-2) was located just upstream of the forest boundary on USFS land and parallels Deep Creek Road. At the site, there were a couple very large (50 – 100 feet high) eroding banks that were limiting channel movement and attributed to the road. Man made rock gabion structures were observed at the toe of the largest eroding banks, which caused scouring and additional bank erosion near the structures as well as on the opposite side of the stream. Stream channel measurements at the site resemble Rosgen types F4b, C4b, B3, and E3b in various cells of the sample reach depending on entrenchment, width/depth ratio, and sediment particle size, but the stream is likely a B channel type that is in disequilibrium. The stream showed evidence of downcutting, undercutting, and lateral movement due to excessive sediment input from the eroding banks and human alteration. Within the sample reach, boulders dominate the substrate and the channel is steep and composed of almost all riffle/run channel forms. The reach has minimal pools, and no spawning habitat was noted due to large cobble substrate.

The most downstream site (DEP 13-2) was located on private property between Deep Creek Road and the former Plum Creek mill near Fortine. The lower reach had no apparent current human impacts. The reach is a Rosgen C4 channel type consisting of a meandering channel through a flat valley with minimal riffle development, some point bar development and long runs. The reach contained many lateral scour and LWD formed pools. Beaver activity is evident downstream of the reach and evidence of recent historical beaver activity is evident within the sampled reach. Bank material includes cobble/gravel deposited over a layer of fines.

In addition to these two monitoring sites, streambank erosion and a qualitative assessment of human impacts was evaluated at one additional site along Deep Creek (DEP 7-1). Site DEP 7-1 was located in the headwaters on public land. No bank erosion was observed within this reach. Some clear cuts were observed near the site but no impacts to the stream were noted. The site is a cascading step-pool system with a steep gradient and lots of woody debris that form dams. The substrate is predominantly large cobble. Several small trout were observed during sampling. The sample site appeared to be meeting its potential and was noted as a good example of reference reach for high elevation tributaries.

Comparison to Water Quality Targets

The existing data in comparison to the targets for Deep Creek are summarized in **Table 5-10**. The macroinvertebrate bioassessment data for Deep Creek is located in **Table 5-11**. All bolded cells represent conditions where target values are not met.

Table 5-10. Existing Sediment-Related Data for Deep Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count (mean)		Grid Toss (mean)		Channel Form (median)		Instream Habitat			Greenline % Shrub Cover
					% < 6mm	% < 2mm	Riffle % < 6mm	Pool % < 6mm	W/D Ratio	Entrenchment Ratio	Residual Pool Depth (ft)	Pools / Mile	LWD / Mile	
DEP 13-2	2008	19.4	C4	C4	14	**11**	6	4	14.4	4.7	1.6	90	533	**34**
DEP 9-2	2008	19.9	B3/F4	B3/C3b	6	3	1	ND	11.9	1.8	1.0	84	**333**	**54**

Values that do not meet the target are in **bold**.

Table 5-11. Macroinvertebrate Bioassessment Data for Deep Creek

Stream Name	Station ID	Location	Collection Date	Collection Method	MMI	O/E
Deep Creek	FORTINE05	4 mi u/s from mouth	8/15/06	Surber	72.98	1.04

Values that do not meet the threshold are in **bold**.

Summary and TMDL Development Determination

The percent fine sediment < 2mm exceeded the target at the lowermost reach (13-2). Understory shrub cover did not meet the target value at both sites, however, the lower site had a high number of wetland herbaceous species and the upper site also had good groundcover acting to stabilize streambanks. The upper site had slightly less LWD than the target value but there were numerous LWD aggregates within the reach that formed dams, retained sediment, and caused channel braiding.

The macroinvertebrate data collected in Deep Creek during 2006 met all applicable target values. It is important to note that the macroinvertebrate sampling site is on USFS land and upstream of the sections of the creek where accelerated bank erosion and excess sediment deposition within the channel were observed.

Altogether, the data collected by DEQ in 2008 suggests some minor level of human-caused negative impact to the coldwater fishery and aquatic life beneficial use. However, due to private property and stream access issues in the lower Deep Creek, the data collected by DEQ in 2008 were spatially limited and not necessarily representative of Deep Creek. Aerial photos and qualitative assessments in 2008 show that grazing practices within riparian areas have largely improved but bank erosion problems remain as originally observed in 2003 and there are still some sections near the mouth with poor riparian buffers. In addition, sediment source assessment information, located in **Section 5.6**, identify potentially significant and controllable human caused sources of sediment throughout the lower watershed. These observations are consistent with the 2003 DEQ data collection that led to a sediment impairment listing for Deep Creek. As a result, sediment TMDL will be prepared for the Deep Creek.

5.4.2.2 Edna Creek

Edna Creek (MT76D004_030) is listed for sedimentation/siltation on the 2010 303(d) List. The Edna Creek watershed falls completely within Northern Rockies ecoregion and the streamflows for approximately 10 miles to its confluence with Fortine Creek. Edna Creek was originally listed in 1992 because of siltation associated with historic riparian harvest and logging, roads, agriculture, and removal of woody debris from the channel.

Physical Condition and Sediment Sources
Various publications from the late 1990s and early 2000 identify sediment impacts to Edna Creek resulting from insufficient BMPs for roads and road network structures, lack of riparian protections, and stream crossings (U.S. Department of Agriculture, Forest Service, Kootenai National Forest, 1998; River Design Group, 2004; U.S. Department of Agriculture, Forest Service, Kootenai National Forest, 2000; U.S. Department of Agriculture, Forest Service, 2002). The most notable observed effects were the quantity and quality of pools, frequency of LWD, and the amount and size of sediment in the channel (U.S. Department of Agriculture, Forest Service, Kootenai National Forest, 1998). A 2002 KNF publication rated the watershed's overall condition as "high concern" based on a combination of sensitivity and disturbance factors and included the road and sensitivity statistics presented below (U.S. Department of Agriculture, Forest Service, 2002).

Total road density rated as high (> 3.5 mi/mi^2), sensitive land type road density rated as high (> 3.0 mi/mi^2 of sensitive land types within watershed), 1 road crossing/mile of road, 4.3 road crossings for mi^2 of watershed (> 3 considered high), 24% effective clear cut area and rated as moderate (15-30% moderate), 54% total disturbance from roads and harvest (> 40% considered high), 8% detrimental soil disturbance. Riparian road density rated high (> 3.0 mi. road/mi^2 of riparian area considered high), # of road crossings/mile of stream rated moderate at 1.8 crossing/mile of stream, 65% intact riparian rated as high potential for disturbance (< 70% rated as high).

In 2003, DEQ performed stream reach assessments at two sites within the Edna Creek watershed (**Figure 5-1**). Pebble counts were performed as well as qualitative assessments of channel conditions, riparian vegetation, and sediment sources. At the upper site (K01EDNAC01), the crew noted lots of gravels and sand and 30-35% embeddedness. At the lower site (K01EDNAC02), embeddedness was 65-70% and although small pools were abundant, pools and spawning substrate were filled with gravel, sand, and silt. LWD was abundant. There was evidence of large tracts of historic timber harvest near the headwaters and a small amount of existing harvest activity. Extensive road crossings were noted as potential sediment sources.

In 2008, DEQ performed a sediment and habitat assessment at one site on Edna Creek (ENA 10-2) and performed an assessment of bank erosion and human impacts to the stream at three other sites. The full assessment site was located just above Forest Service Road 3588, and no human impacts were noted within the reach other than the road crossing downstream of the reach. The stream channel in this reach is a B4c/C4 Rosgen channel type that also resembles an F4 channel type in areas due to various cells within the reach being entrenched. Some historic beaver activity is present and some areas appear to be over widened.

The uppermost bank erosion assessment site (ENA 7-2) was a step-pool system with a significant amount of large woody debris, and the site had no apparent human impacts. The next downstreambank erosion assessment site (ENA 8-1) also had no visible sign of human impact. This reach was also a steep step-pool system and though the road paralleled most of the reach it was 50 – 100 feet off the stream and had no apparent influence. The lowermost bank erosion assessment site (ENA 11-1) was located approximately 0.7 miles upstream of the confluence with Fortine Creek. The site was observed to be heavily impacted by agriculture and the surrounding land is actively hayed. Surveyors noted high amounts of fine sediment deposited within the reach and few stretches of gravel. Though elevated fines were observed, this may be a natural condition given that the reach was a low gradient E stream type and the existence of beaver dams acting to reduce flushing flows. The site had many multi-channel segments, suggesting current and historic beaver activity as well as historically eroding streambanks. Just downstream of the assessment site, the stream appeared to be in a state of active channel migration, which is assumed to be from beaver activity. Riparian buffers were essentially nonexistent throughout the reach, although there was a dense mat of reed canary grass. Aerial imagery of this site shows old meander scars within the adjacent hay meadows suggesting that the reach was channelized historically. Many of the mid-channel clumps of willow and bank material may be the channel attempting to dissipate its energy and regain its sinuosity. In summary, riparian harvest and the removal of woody debris from the active channel and streambanks as well as channelization has destabilized the lower reaches of Edna Creek.

Comparison to Water Quality Targets

The existing data in comparison to the targets for Edna Creek (ENA) are summarized in **Table 5-12**. The macroinvertebrate bioassessment data for Edna Creek is located in **Table 5-13**. All bolded cells represent conditions where target values are not met.

Table 5-12. Existing Sediment-Related Data for Edna Creek relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count (mean)		Grid Toss (mean)		Channel Form (median)		Instream Habitat			Greenline % Shrub Cover
					% < 6mm	% < 2mm	Riffle % < 6mm	Pool % < 6mm	W/D Ratio	Entrenchment Ratio	Residual Pool Depth (ft)	Pools / Mile	LWD / Mile	
ENA 10-2	2008	22.3	B4c/F4	B4c/C4	14	**9**	3	**14**	**21.5**	1.5	1.2	90	702	90
K01EDNAC02	2003	--	--	--	**41**	**33**	--	**--**	**--**	--	--	--	--	--
K01EDNAC01	2003	--	--	--	**49**	**31**	--	**--**	**--**	--	--	--	--	--

Values that do not meet the target are in **bold**.

Table 5-13. Macroinvertebrate Bioassessment Data for Edna Creek

Stream Name	Station ID	Location	Collection Date	Collection Method	MMI	O/E
Edna Creek	K01EDNAC02	Near mouth and u/s of FS 3588 bridge	8/13/03	Kick	76.13	0.93
Edna Creek	K01EDNAC01	Near headwaters and 0.9 mi d/s from FS 3581	8/13/03	Kick	85.12	1.09
Edna Creek	FORTINE06	Near mouth	8/21/06	Surber	72.28	0.97

Values that do not meet the target threshold are in **bold**.

Summary and TMDL Development Determination

Both reaches assessed in 2003 failed to meet the pebble count fine sediment targets. During the 2008 stream assessment, fine sediment values were much less than in 2003 but ENA 10-2 failed to meet the target for fine sediment < 2mm via riffle pebble count and the target for pool tail grid toss. Half of the cells within the reach were not meeting the potential C4 stream type and had an F4 stream type, suggesting that the stream is entrenched and/or downcut. Likely as a result of overwidening in sections, the reach had a W/D ratio slightly larger than the target value. Due to the large substrate within the banks, bank erosion did not appear to be accelerated by these entrenched areas. The most downstream reach had some slowly eroding banks attributed to cropland but bank erosion along all other reaches was attributed to natural sources.

Macroinvertebrate data met threshold values at all sites. Although the biological indices indicate sediment may not be impairing macroinvertebrates, elevated levels of fine sediment in riffles and pool tails indicate that the sediment supply is overwhelming the transport capacity of the system and suggests the aquatic life and coldwater fish beneficial use is continuing to be negatively affected by human sources. B channels tend to be quite resilient, as noted in the 2002 KNF report, but the Edna Creek watershed is highly sensitive to disturbance. Particularly in the entrenched sections where the stream is an F channel, Edna Creek may still be attempting to regain some equilibrium of channel form, function, and sediment transport. During the 2008 assessment, numerous well-maintained BMPs were observed throughout the watershed including: waterbars at road crossings, appropriate streamside management zones (SMZ) applied to logged areas, and the existence of a new, appropriately-sized culvert. However, it appears that Edna Creek is still recovering from intense historic land management within the watershed, and it is important that recent BMPs continue to be maintained and that additional BMPs are implemented. The primary anthropogenic sources of sediment within the watershed include unpaved roads, logging, near-stream agriculture, and riparian vegetation removal. Because of the existing 303(d) listing, sensitivity of the Edna Creek watershed to disturbance, and recent data suggesting sediment-related impacts to beneficial uses, a sediment TMDL will be prepared for Edna Creek.

5.4.2.3 Fortine Creek

Fortine Creek (MT76D004_020) is listed for sedimentation/siltation on the 2010 303(d) List. In addition, Fortine Creek is also listed for alteration in streamside or littoral vegetative covers and flow alteration, which is a form of pollution commonly linked to sediment impairment. Fortine Creek was originally listed in 1990 based on FWP data regarding sediment loading and channel siltation, and probable sources were cited as grazing, logging, and land development. The Fortine Creek watershed falls completely within Northern Rockies ecoregion and the streamflows for approximately 30 miles to its confluence with Grave Creek, forming the headwaters of the Tobacco River.

Physical Condition and Sediment Sources

In the early 1900s, Fortine Creek was used as a conduit for timber harvested within the watershed, and log drives, in conjunction with harvesting and channelization from roads and the railroad, have contributed to long lasting changes to channel sinuosity, shifts in stream energy, channel entrenchment, loss of floodplain access, and bank erosion (River Design Group, 2004; U.S. Department of Agriculture, Forest Service, Kootenai National Forest, 2004).

In 2003, DEQ performed stream reach assessments at three sites within the Fortine Creek watershed (**Figure 5-1**). Pebble counts were performed as well as qualitative assessments of channel conditions, riparian vegetation, and sediment sources. The uppermost reach (K01FORTC010) was located near the headwaters on USFS land and moderate sediment deposition was noted in riffle margins with moderate to heavy deposition in the pools. Timber harvest was common but mostly out of the riparian area. Portions of the reach were heavily grazed and observed to be contributing to a lack of woody vegetation in the riparian and increased bank erosion. Both of the downstream sites (K01FORTC020 and K01FORTC020) contained a mixture of unstable areas with excessive bank erosion and stable forested sections with well armored streambanks. Moderate to high sediment deposition was observed in pools and riffles were affected by sand deposition. Some natural erosion of ancient lake bed sediment was observed and anthropogenic sediment sources were primarily associated with grazing and channelization and habitat alterations associated with the railroad.

Sediment and habitat assessments were performed at eleven sites on Fortine Creek in 2008 (**Figure 5-1**). Of the eleven sites visited in 2008, five were full assessment sites and six were bank erosion-only sites. The uppermost full assessment site (FTN 4-3) was located on USFS land approximately 4.5 miles upstream of the confluence of Swamp Creek. The reach assessed was just upstream from the entrance to the railroad tunnel where the stream is not encroached upon by either the railroad or the Fortine Creek road. Severe grazing impacts were noted throughout the upper end of the assessment reach. Riparian vegetation in this area was trampled and high fines were observed within the stream channel. The stream throughout the reach resembled a Rosgen C4 stream type. The sample reach meandered though a meadow and had a very low gradient, few riffles, long scour pools, and minimal woody debris. Evidence of beaver activity was noted. Bank erosion at this site was predominately natural, except for one large eroding bank associated with cattle access to the stream.

The next downstream full assessment site (FTN 6-1) was located on state land approximately 2 miles upstream of the confluence with Swamp Creek. At this site, Fortine Creek was on the east side of the railroad and the upper and lowermost portions of the sample reach abutted the railroad. The stream was channelized in these areas and riprap was placed along the channel margins. In addition to the railroad impacts, some historic riparian logging activity was observed at the site. The reach is a B3c/B4c channel type which resembles an F3 in areas due to encroachment and channelization from the railroad, and subsequent entrenchment of the channel. The middle of the assessment reach pulled away from the railroad and appeared more natural in its channel dimension, pattern, and profile. Within the middle of the assessment reach, the stream was meeting its potential Rosgen stream type of a B3. Some beaver activity was noted in the upper and lower segments flanking the railroad. Bank erosion at this site was affected by the channelization and shifts in stream energy.

The next downstream site (FTN 9-3) was located on USFS land approximately 0.3 miles below the Swamp Creek Road crossing on Fortine Creek. At this site the only human impact noted included observations of historic riparian logging. The reach is a Rosgen B4c\C4 stream type, with a slow and meandering channel pattern. The reach consisted of long pools and short sporadic riffles. Surveyors noted that the stream was overwidened in places where the channel appeared to be aggrading. Limited spawning habitat was noted due to large substrate, and the surveyors noted a fine coating of sediment on the channel substrate. Bank erosion at this site was minimal.

The next most downstream assessment site (FTN 12-7) was located on private land just downstream of the Loon Lake Road crossing at Fortine Creek, near Trego, Montana. Land use within the reach was predominantly agricultural, including cattle grazing and hay production. The site was severely affected by near-stream grazing and had a heavily browsed riparian area and extensive bank erosion. The survey crew noted some apparent restoration attempts observed near the upper end of the assessment reach including riparian fencing and willow planting, however, an attempt to fence out cattle from the stream in this area was unsuccessful. The stream at this site was a Rosgen B4c\C4 stream type. The channel was overwidened in places due to near-stream grazing, cattle access to the stream, and bank trampling. The large substrate was embedded in a layer of silt and excessive fines were observed throughout the reach. Alders, willows and other wetland vegetation exist where grazing impacts were minimal.

The most downstream full assessment site (FTN 13-1) was located on state land approximately 0.4 miles upstream of the Fortine and Deep Creek confluence, near Fortine, Montana. The assessment reach was laid out within a meandering section of Fortine Creek that was situated away from the railroad and heavily forested on both sides of the stream. The stream channel was a Rosgen B4c/C4 that resembled an F channel type due to severe entrenchment. Within the reach, there were multiple compound pools with infrequent small riffles. Bank erosion was minimal, however, massive bank failure and erosion was observed on many outside meander bends upstream of the assessment reach. At these locations, the stream appeared to be severely entrenched and/or downcut. The entrenched nature of the reach and nearby areas are believed to be remnants of past logging and log drive practices that were implemented through the turn of the twentieth century (KNF 1998).

In addition to these five monitoring sites, streambank erosion and a qualitative assessment of human impacts was evaluated at six additional sites along Fortine Creek. Several of the sites had portions with adequate riparian buffers or recently installed riparian fencing to reduce grazing impacts, but channel entrenchment and bank erosion were observed throughout the sites and attributed to historic logging in the riparian zone, railroad and road encroachment, channelization, and near-stream grazing. In some cases, only historic impacts were noted and these reaches appeared to be in an active state of recovery from past impacts.

Comparison to Water Quality Targets

The existing data in comparison to the targets for Fortine Creek (FTN) are summarized in **Table 5-14**. The macroinvertebrate bioassessment data for Fortine Creek is located in **Table 5-15**. All bolded cells represent conditions where target values are not met.

Table 5-14. Existing Sediment-Related Data for Fortine Creek Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count (mean)		Grid Toss (mean)		Channel Form (median)		Instream Habitat			Greenline % Shrub Cover
					% < 6mm	% < 2mm	Riffle % < 6mm	Pool % < 6mm	W/D Ratio	Entrenchment Ratio	Residual Pool Depth (ft)	Pools / Mile	LWD / Mile	
FTN 13-1	2008	34.5	B4c/F4	B4c	12	8	7	**9**	25.3	1.5	1.7	58	391	77
FTN 12-7	2008	62.5	B4c/C4	B4c/C4	13	**9**	**13**	**18**	**51.6**	1.7	**1.5**	63	**100**	**33**
FTN 9-3	2008	29.5	B4c/C4	B4c/C4	8	6	1	3	20.2	1.8	1.7	**37**	**100**	**30**
FTN 6-1	2008	21.2	B4c/F4	B3c/B4c	9	**5**	**12**	**11**	**24.0**	1.5	1.0	84	**227**	91
FTN 4-3	2008	22.3	C4	C4	13	8	5	5	17.3	3.0	1.7	53	**132**	61
K01FORTC010	2003	--	--	--	**19**	**13**	--	**--**	**--**	--	--	--	--	--
K01FORTC020	2003	--	--	--	**19**	**19**	--	**--**	**--**	--	--	--	--	--
K01FORTC030	2003	--	--	--	**19**	**15**	--	**--**	**--**	--	--	--	--	--

Values that do not meet the target are in **bold**.

Table 5-15. Macroinvertebrate Bioassessment Data for Fortine Creek

Stream Name	Station ID	Location	Collection Date	Collection Method	MMI	O/E
Fortine Creek	K01FORTC20	0.25 east of FS Rd 3651	8/10/03	Kick	65.05	1.34
Fortine Creek	K01FORTC10	1 mi d/s of upper W Fortine Ck Rd crossing	8/10/03	Kick	75.49	1.10
Fortine Creek	K01FORTC30	0.3 mi u/s of mouth	8/11/03	Kick	65.61	**0.76**
Fortine Creek	FORTINE07	0.3 mi u/s of Swamp Creek	8/17/06	Surber	**53.49**	**0.49**

Values that do not meet the target are in **bold**.

Summary and TMDL Development Determination

All three sites assessed in 2003 had similar fine sediment values and failed to meet the pebble count targets. During the 2008 assessment, percent fine sediment data as compared to targets show mixed results. All reaches assessed met the < 6.35mm pebble count riffle target, but pebble count fine sediment < 2mm as well as riffle and pool spawning habitat grid toss targets were exceeded at various locations throughout the watershed. Reach FTN 12-7, which was observed as having severe grazing impacts and bank erosion, was one of two reaches that failed to meet the W/D ratio target and the only reach failing to meet the residual pool depth target. The average bankfull width for this site was nearly 63 feet with a maximum of 93 feet measured at the most overwidened cross-section. Likely as a result of riparian grazing and historic logging, several reaches failed to meet the target for LWD and greenline shrub cover. Examination of greenline assessment forms indicate FTN 9-3 was limited in shrub cover and had some invasive weed issues but overall had fairly healthy riparian vegetation and a buffer greater than 200 feet throughout most of the reach. The upper section of FTN 12-7 had evidence of tree plantings, but overall the riparian vegetation was well below its potential due to severe overgrazing in much of the reach. This supports the listing for alteration in streamside or littoral vegetative covers and indicates an imbalance in habitat factors important for upland and in stream sediment retention and fish cover. Bank erosion at five of the reaches was predominantly related to natural sources, and bank erosion at the other six reaches was attributed to grazing, historic logging, and encroachment from roads or the railroad.

Of the four macroinvertebrate samples collected in Fortine Creek, one sample collected in 2006 failed to meet both metrics and a sample collected in 2003 did not meet the O/E target. For the sample not meeting the O/E target, the corresponding MMI value is only slightly above the target value (i.e., 63), which indicates more weight should be given to the O/E value. The burrowing taxa at the sites not meeting one or both metrics are elevated relative to sites meeting both metrics, which also indicates excess sediment is impairing macroinvertebrates within Fortine Creek.

The elevated percent of surface fine sediment in riffles and pool tails and high rates of bank erosion associated with human sources indicate an increased sediment supply and a decreased capacity to transport sediment, particularly in the lower watershed. These conditions are contributing to impairment of the macroinvertebrate community and likely limiting fish habitat quality and affecting spawning and rearing success. The primary anthropogenic sources of sediment within the watershed include near-stream grazing, roads, bank erosion, and timber harvest. This information supports the 303(d) listing and a sediment TMDL will be completed for Fortine Creek.

5.4.2.4 Lime Creek

Lime Creek (MT76D004_050) is listed for sedimentation/siltation on the 2010 303(d) List. In addition, Lime Creek is also listed for alteration in streamside or littoral vegetative covers, which is a form of pollution commonly linked to sediment impairment. Lime Creek was originally listed in 1996 based on sedimentation attributed to grazing, logging, and roads. The Lime Creek watershed is situated within the Northern Rockies ecoregion and the streamflows for approximately 4 miles to its confluence with Fortine Creek.

Physical Condition and Sediment Sources

Although limestone geology is prevalent in the upper Fortine Creek watershed and a source of calcium enrichment to its waters, Lime Creek is the only sediment-listed stream in the Tobacco TPA where the entire stream is underlain by limestone geology (**Figure A-3**), which heavily influences the geomorphology of the stream. Sections of Lime Creek are aggrading as a result of calcium carbonate precipitating out of solution, depositing on the bottom, and elevating the base level of the channel (River Design Group, 2004). This phenomenon can reduce the ability of the stream to transport sediment, resulting in increased bank scour and channel instability. Geomorphological conditions of this nature are common in watersheds dominated by re-precipitating calcium carbonate and high rates of deposition. Another product of the increased production and deposition of calcium carbonate is a channel bed dominated by a fine calcium rich substrate. During DEQ field work in 2008, Lime Creek was the only assessed stream where this phenomenon was observed to be a major factor in-channel conditions (**Figure 5-2**).

Figure 5-2. Calcium carbonate precipitate on the channel bottom in Lime Creek upstream of FS Road 3780 (left) and causing a chalky color in the water column at LME 6-1 (right).

In 2003, DEQ performed a pebble count and a qualitative assessment of channel conditions, riparian vegetation, and sediment sources at a site near the mouth (K01LIMEC01) (**Figure 5-1**). The assessor noted severe grazing impacts to the lower 0.5 mile of stream with bank failure, hoof shear, downcutting, and channel overwidening. The thick topsoil was observed to be very erosive where riparian vegetation was absent, and siltation in the lower 2.5 miles of the stream was noted as a major concern. Riparian timber harvest was observed on private land as well as slash in the channel.

The Kootenai National Forest conducted channel measurements at two reaches in 2004 and 2005. One reach was a B4 channel type with low potential for bank erosion, a moderate sensitivity to disturbance, and a good Pfankuch channel stability rating (Pfankuch, unpublished 1978), and the other reach was a A4/F4b channel type with a high sensitivity to disturbance, a high potential for bank erosion, and a fair Pfankuch channel stability rating (USDA Forest Service, Kootenai National Forest, 1996). The carbonate geology and past management of the riparian zone have contributed to common head cuts and frequent channel changes (River Design Group, 2004). Many of the historic impacts and associated sediment sources within the Lime Creek watershed are in an active state of self restoration.

In 2007, DEQ conducted nutrient sampling on Lime Creek near forest road 3780 and field notes cited evidence of cattle grazing along the entire sample reach, including hummocking and several cattle crossings. A layer of fine sediment was observed on the substrate throughout the reach with "mucky, thick sediment" in pools and at cattle access points. During 2008, DEQ evaluated one full assessment site on Lime Creek (LME 6-1) (**Figure 5-1**). This site was located approximately 2.5 miles upstream of the Lime Creek confluence with Fortine Creek, and just downstream of the forest road 3770 Lime Creek crossing. Within the reach, minimal current human impacts were noted, however the perched road culvert at the upper end of the reach may be causing some elevated erosion on streambanks below the crossing. Some evidence of historic logging was observed at the upper end of the reach. Stream channel measurements suggest that the existing stream type is a E4b channel with a high entrenchment ratio and low width/depth ratio. This stream type is expected given the influence of calcium carbonate noted above. Lots of fines were observed within the channel bed and field notes document calcium carbonate deposits describing the stream bed as having "a chalky appearance from eroded limestone."

Comparison to Water Quality Targets

The existing data in comparison to the targets for Lime Creek (LME) are summarized in **Table 5-16**. The macroinvertebrate bioassessment data for Lime Creek is located in **Table 5-17.** All bolded cells represent conditions where target values are not met.

Table 5-16. Existing Sediment-Related Data for Lime Creek relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count (mean)		Grid Toss (mean)		Channel Form (median)		Instream Habitat			Greenline % Shrub Cover
					% < 6mm	% < 2mm	Riffle % < 6mm	Pool % < 6mm	W/D Ratio	Entrenchment Ratio	Residual Pool Depth (ft)	Pools / Mile	LWD / Mile	
LME 6-1	2008	7.5	E4b	E4b	**35**	**21**	**17**	ND	6.7	2.9	**0.5**	**74**	465	**53**
K01LIMEC01	2003	--	--	--	**75**	**74**	--	**--**	**--**	--	--	--	--	--

Values that do not meet the target are in **bold**.

Table 5-17. Macroinvertebrate Bioassessment Data for Lime Creek

Stream Name	Station ID	Location	Collection Date	Collection Method	MMI	O/E
Lime Creek	K01LIMEC01	0.25 mi u/s of mouth	8/12/03	Kick	**39.18**	**0.70**
Lime Creek	K01LIMEC02	2.5 mi u/s of mouth; just downstream of LME 6-1	7/24/08	Kick	72.57	**0.78**

Values that do not meet the target are in **bold**.

Summary and TMDL Development Determination

The reach assessed in 2003 did not meet the pebble count fine sediment targets, and the 2008 assessment reach (LME 6-1) did not meet either of the fine sediment pebble count targets or the riffle grid toss target. The reach also did not meet the target for residual pool depth and was slightly less than the targets for pool frequency and greenline percent shrub cover. The greenline assessment notes indicate that shrub cover number was reduced below the target because of a section with 30 percent shrub cover but that overall the riparian vegetation was in very good condition with a dense overstory and understory. Given that the carbonate geology is a major driver of fine sediment percentages and channel morphology in Lime Creek, the Tobacco TPA targets (**Table 5-3**) may not be entirely applicable to Lime Creek.

The 2003 macroinvertebrate sample from the site near the mouth did not meet the target value for either metric, indicating impairment. The macroinvertebrate sample collected in 2008 was slightly below the O/E target, but based on the corresponding MMI score being quite a bit above the target, this sample does not indicate impairment.

Due to the limestone geology of Lime Creek, the percentage of fine sediment within the channel bed is likely naturally greater than the target value (i.e., 15% < 6mm) and the potential for pool frequency and residual pool depth may be less than for other sediment-listed streams in the Tobacco TPA. However, based on observed anthropogenic sediment sources including riparian vegetation removal, near-stream grazing, bank erosion, and roads, these sources have also altered channel morphology and increased the fine sediment load. Recent data and field observations suggest Lime Creek is recovering from historic management practices, but because it is still recovering and is a system highly sensitive to disturbance, a sediment TMDL will be developed for Lime Creek.

5.4.2.5 Sinclair Creek

Sinclair Creek (MT76D004_091 and MT76D004_092) was never previously formally assessed by DEQ for beneficial use support and therefore did not appear on the 2010 303(d) List. Due to stakeholder input, high resource value based on occasional use by juvenile bull trout for extended rearing, and the existence of potentially significant controllable sediment sources, Sinclair Creek was added to the list of streams evaluated during this TMDL assessment. Sinclair Creek flows approximately 11 miles from the headwaters to the confluence with the Tobacco River within the Town of Eureka, Montana, but is divided into two waterbody segments with the upper segment contained within the Canadian Rockies and the lower segment within the Northern Rockies ecoregion. The lower segment MT76D004_091, was the focus of this assessment, and extends 7.9 miles from an unnamed tributary to the mouth.

Physical Condition and Sediment Sources

Sediment and habitat assessments were performed at two monitoring sites on Sinclair Creek in 2008. The uppermost full assessment site (SNC 8-2) was located on private property approximately 5 miles upstream of the mouth. Active grazing lands were noted on both sides of the stream, however, current impacts to the stream were minimized due to the existence of riparian fencing. The reach has a potential Rosgen stream type of a B4c/C4 type channel, but resembles a F4 type channel in areas due to downcutting in the stream channel and low entrenchment ratios. Overall, the stream reach was noted to be in good morphological structure with high numbers of woody debris and quality pools. Riparian vegetation at this reach was composed of older stands of even-aged alder and hawthorn. Grazing impacts to the vegetation were evident but appeared in a state of recovery. A dead bull trout was observed within the reach. Eroding streambanks were prevalent at this site and were located on the outside of meander bends. Impacts from grazing was noted as the primary cause, however as with the riparian vegetation, this erosion seemed to be recovering due to fencing out the cattle.

The lowermost full assessment site (SNC 10-3) was located approximately 0.2 miles upstream of the Sinclair Creek confluence with the Tobacco River, within the town of Eureka. This stream reach was encroached by roads on both sides, and high amounts of fines were observed on the channel bottom. The deposition of fines in this reach is a combination of significant sources of sediment upstream and deposition from culvert backup downstream the reach. Debris such as tires, metal, coolers, and garbage exist throughout the reach. The stream reach is a Rosgen B4c and B5c due to high amounts of fine sediment. The stream reach was observed as having few small riffles and being overwidened in many areas. The stream channel appeared to be aggrading, probably due to backup from the downstream culvert. The riparian vegetation was noted in good health considering extensive human alteration. All eroding banks within this reach were stratified with a layer of sand and rated as slowly eroding. Erosion sources were predominately cited as channelization between the roads but also had some influence from residential developments.

In addition to these two monitoring sites, streambank erosion and a qualitative assessment of human impacts was evaluated at one additional site along Sinclair Creek (SNC 5-1). The reach was located in the headwaters on public land and had no signs of human impact. The reach was a cascading step pool system with lots of LWD and large boulders. The surveyors observed evidence of a large flood that moved very large boulders (> 3 feet) well out into the floodplain. All eroding streambanks observed within the reach were attributed to natural sources.

In June of 2006, Sinclair Creek experienced a significant flood event in response to consecutive days of above average precipitation. The storm generated widespread flooding throughout the watershed and damaged infrastructure including approximately 225 feet of the main Sinclair Creek Road. Post flood surveys were conducted by River Design Group and the U.S. Fish and Wildlife Service in July of 2006. Observations confirmed that the morphology and stability of Sinclair Creek had been compromised as a result of the emergency actions and flood impacts. The post flood survey documented accelerated channel migration, bank erosion, downcutting, loss of floodplain connectivity, and impacts to aquatic habitat (River Design Group, Inc., 2009).

Comparison to Water Quality Targets

The existing data in comparison to the targets for Sinclair Creek (SNC) are summarized in **Table 5-18**. All bolded cells represent conditions where target values are not met. No macroinvertebrate data was available for Sinclair Creek.

Table 5-18. Existing Sediment-Related Data for Sinclair Creek relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count (mean)		Grid Toss (mean)		Channel Form (median)		Instream Habitat			Greenline % Shrub Cover
					% < 6mm	% < 2mm	Riffle % < 6mm	Pool % < 6mm	W/D Ratio	Entrenchment Ratio	Residual Pool Depth (ft)	Pools / Mile	LWD / Mile	
SNC 10-3	2008	21.1	B4c/B5c	B4c	**41**	**28**	**54**	**98**	17.7	1.4	**0.9**	90	253	**15**
SNC 8-2	2008	20.8	C4/F4	B4c/C4	12	**9**	3	2	20.3	**1.6**	**1.1**	90	634	69

Values that do not meet the target are in **bold**.

Summary and TMDL Development Determination

During the 2008 assessments, SNC 10-3 exceeded all pebble count and grid toss targets, with the grid toss in potential pool spawning habitats almost reaching one hundred percent fines < 6mm. The other reach (SNC 8-2) had much lower fine sediment percentages and only slightly exceeded the pebble count target for fines < 2mm. The width/depth values met the target at both sites, but because SNC 8-2 was an entrenched F channel in sections, it did not meet the target for entrenchment ratio. Although channel morphology targets were met in reach SNC 10-3, aggradation was noted and extensive incisement and downcutting was observed above the reach just below the stream's first crossing of HWY 93. Pool frequency and LWD targets were met in both reaches. Both reaches did not meet the residual pool depth target, but the channel bankfull width was close to the 20-foot cutoff and did meet the target for channels < 20 feet wide. Based on field observations, sediment is likely not affecting residual pool depth in reach SNC 8-2, but the aggradation of the stream channel within the SNC 10-3 reach has reduced the residual pool depth, and could be affecting the quality of pool habitat. Some eroding banks appear to be recovering as a result of improvements in grazing practices, but remaining human sources contributing to bank and hillslope erosion include at least two livestock confinement areas bordering the stream and a stream diversion that returns to Sinclair Creek, nearby residential development, at least two major road erosion sources (see example in **Figure 5-3**), and channelization from roads. Understory vegetation targets were not met within reach SNC 10-3, however, it was noted that riparian fencing was having a positive impact on this reach and that vegetation was relatively good considering road encroachment on both sides of the channel.

These results indicate that although some recovery is occurring, current and historic human impacts are negatively effecting sediment production, transport, and deposition within Sinclair Creek. Near-stream grazing in riparian zones, road encroachment, and haying activities have contributed to elevated fines levels, overwidened sections of stream channel, and accelerated bank erosion, which are likely limiting the aquatic life beneficial use. Therefore, a sediment TMDL will be developed for Sinclair Creek.

Figure 5-3. An unpaved road sediment source near Sinclair Creek, shown in dry conditions and during a runoff event

5.4.2.6 Swamp Creek

Swamp Creek (MT76D004_040) is listed for sedimentation/siltation on the 2010 303(d) List. In addition, Swamp Creek is also listed for alteration in streamside or littoral vegetative covers and flow alterations, which is a form of pollution commonly linked to sediment impairment. Swamp Creek was originally listed in 1992 based on turbidity during low flow and sedimentation attributed to roads, riparian harvest, and logging. Swamp Creek extends 11 miles from the headwaters its confluence with Fortine Creek.

Physical Condition and Sediment Sources

In 2003, DEQ performed an assessment 0.1 miles from the mouth (K01SWMPC02) and noted logged areas with channel incision and more lateral erosion but a fair amount of vegetation stabilizing streambanks. Both logged areas and the lower section of the reach had sediment deposition in pools and along riffle margins. Also, mass wasting was observed lower reach sections. Potential sediment sources were cited as culverts, timber harvest (historic and present), and grazing. The Swamp Draft Environmental Impact Statement (U.S. Department of Agriculture, Forest Service, Kootenai National Forest, 1998) noted that basin surveys indicated a lack of adequately sized and spaced pools, insufficient LWD, and poor substrate are all factors limiting aquatic life in Swamp Creek. These factors were attributed to removal of debris dams, upland land management, check dams, and riparian tree harvesting and mortality from mountain pine beetles.

In 2008, sediment and habitat assessments were performed at three locations throughout Swamp Creek from the headwaters to its mouth. Of these three sites, two were full assessment sites and one was a bank erosion only site. The uppermost full assessment site (SWP 5-1) was located just downstream of the Forest Road 3553 crossing on Swamp Creek on USFS land. Human impacts within the reach include historic riparian logging, minor grazing impacts, and old grade control structures. A new pipe arch bridge exists at the upstream end of the reach, which appears to be causing some localized overwidening. The reach is a Rosgen B4 stream type, with areas resembling an F4b stream type due to entrenchment. The stream in this area has a predominantly large gravel substrate (i.e., D50 = 60mm). At the time of the assessment, streamflow was extremely low as compared to the channel size, and the flow went subsurface at one time within the reach. LWD was significant throughout the entirety of the assessment reach. Some bank erosion at this site was attributed to natural sources but historic riparian logging was cited as the predominant factor. The grade control structure noted in the lower portion of the reach was actually a high stage check dam installed in 1992. During the high runoff of 1995, these structures washed out and now excessive bedload deposition and aggradation is occurring at these sites (River Design Group, 2004). Plunge pool formation formed downstream of the check dams may be a fish barrier at low water.

The lowermost full assessment site (SWP 9-1) was located on USFS land approximately 0.4 miles upstream of the mouth of Swamp Creek. Minimal human influence was observed at this site. The upland forest had been clearcut at the lower end of the reach, but a buffer of at least 100 feet was present. The stream was a Rosgen type B3\C3b within the sample reach. The stream reach is a step-pool system throughout the upper end of the assessment reach, with large cobbles and boulders. Surveyors noted that the amount of woody debris appeared low but could be natural for this system. Bank erosion was very low and attributed to natural sources.

The bank erosion assessment reach (SWP 3-1) was located on USFS land just upstream of Forest Road 3560 Swamp Creek crossing. Historic riparian harvest was the only human impact noted at this site. The site was a step-pool system with high amounts of woody debris. Bank erosion was minimal at this site with a small percentage associated with historic logging but more than 90 percent of eroding banks attributed to natural sources.

A review of the most current aerial imagery for Swamp Creek (2009) identifies 1.5 miles of current human impacts to the stream on private land approximately 3.5 miles upstream of the mouth. Within this relatively flat, unconfined valley, the creek appears to be mostly devoid of riparian vegetation, and it also appears that much of the flow was routed into a straight manmade channel that eliminates much of the water from a large meander bend. DEQ was not able to ground truth this area to more fully evaluate the near stream management practices currently in place. Since DEQ did not have access to this area in 2008 it is assumed that the impacts are leading to significant habitat alterations, particularly channelization and entrenchment stemming from hay production, riparian clearing, and near stream grazing.

Comparison to Water Quality Targets

The existing data in comparison to the targets for the Swamp Creek (SWP) are summarized in **Table 5-19**. The macroinvertebrate bioassessment data for the Swamp Creek is located in T**able 5-20**. All bolded cells represent conditions where target values are not met.

Table 5-19. Existing Sediment-Related Data for Swamp Creek relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count (mean)		Grid Toss (mean)		Channel Form (median)		Instream Habitat			Greenline % Shrub Cover
					% < 6mm	% < 2mm	Riffle % < 6mm	Pool % < 6mm	W/D Ratio	Entrenchment Ratio	Residual Pool Depth (ft)	Pools / Mile	LWD / Mile	
SWP 9-1	2008	35.9	B3/C3b	B3/C3b	6	4	2	ND	23.2	2.1	**1.2**	42	164	**51**
SWP 5-1	2008	24.8	B4/F4b	B4	11	7	5	5	**23.7**	1.6	**0.7**	90	**201**	79
K01SWM PC02	2003	--	--	--	**29**	**24**	--	**--**	**--**	--	--	--	--	--

Values that do not meet the target are in **bold**.

Table 5-20. Macroinvertebrate Bioassessment Data for Swamp Creek

Stream Name	Station ID	Location	Collection Date	Collection Method	MMI	O/E
Swamp Creek	K01SWMPC02	0.1 mi upstream from mouth	8/12/03	Kick	67.20	1.30
Swamp Creek	FORTINE08	0.4 mi upstream from mouth; downstream end of SWP 9-1	8/17/06	Surber	**37.60**	**0.26**

Values that do not meet the target are in **bold**.

Summary and TMDL Development Determination

Pebble count fine sediment targets were exceeded in 2003 but all fine sediment targets were met for both full assessment sites in 2008. The width/depth ratio exceeded the target at SWP 5-1, indicating an overwidened channel. Pool frequency indicators were met at both sites, however the residual pool depth indicators were not. Both sites were noted as having predominantly large cobble and boulders, and particularly at site SWP 5-1, aggradation of coarse bedload is likely limiting the pool quality. Although the values were relatively close to the targets, one reach failed to meet the LWD target and the other failed to meet the greenline shrub cover target; a review of field notes for both parameters indicates both values are close to or near the potential for the sites.

Macroinvertebrate data collected in Swamp Creek met both targets values in 2003 but failed to meet both targets in 2006. Although fine sediment values were meeting targets at the 2008 assessment reaches, the burrowing taxa at the 2006 macroinvertebrate site were elevated relative to the 2003 site, indicating excess fine sediment is likely impairing macroinvertebrates. This difference between fine sediment values at the assessment reaches and macroinvertebrate health could be because excess fine sediment was flushed downstream between 2006 and 2008 or because excess fine sediment accumulation is patchy throughout the system.

Recent field observations combined with channel morphology, pool depth, and riparian habitat measures support the 303(d) listing for habitat alteration and also indicate coarse sediment has aggraded sections of Swamp Creek. Although the 2006 macroinvertebrate sample indicates impairment associated with fine sediment, excess coarse sediment can also alter the composition and diversity of macroinvertebrate taxa (Rice, et al., 2001) and decrease fish habitat, food availability, and productivity

(May and Lee, 2004; Sullivan and Watzin, 2010). Riparian grazing roads are contributing sources but the most significant human sources are associated with historic grade control structures and logging practices. Therefore, recent data support the 303(d) listing and a sediment TMDL will be written for Swamp Creek.

5.4.2.7 Therriault Creek

Therriault Creek (MT76D004_070) is listed for sedimentation/siltation on the 2010 303(d) List. Therriault Creek's headwaters originate in the Canadian Rockies ecoregion and the streamflows for approximately 9 miles to its confluence with the Tobacco River. Therriault Creek was originally listed in 1988 based on sedimentation attributed to agriculture, roads, and channel instability resulting from channel straightening and alterations.

Physical Condition and Sediment Sources

A channel and fish habitat survey conducted by FWP and USFS in 1996 noted approximately 4,500 feet of the stream channel was eroding and downcutting due to past alterations and land use activities (River Design Group, 2004). Within this section of stream, located approximately 1.5 miles upstream the US Hwy 93 crossing, it was estimated that 7,000 cubic yards of sediment eroded into the channel in response to straightening and realignment in the early 1900s as well as during subsequent downcutting (River Design Group, 2004). This area was targeted for active restoration in 2004 and 2005 by the KRN with support from the landowner, FWP, the USFWS Partners for Wildlife Program, and the Bonneville Power Administration. The restoration project was aimed at restoring the proper channel form and function and reestablishing 55 acres of drained wetlands adjacent to the stream channel. The project involved 9,200 feet of new channel construction, installation of 70 fish habitat structures and planting of 10,000 native shrubs and trees.

A 2002 KNF publication rated the watershed's overall condition as "high concern" based on a combination of sensitivity and disturbance factors and included the road and sensitivity statistics presented below (U.S. Department of Agriculture, Forest Service, 2002).

> Total road density rated as high (> 3.5 mi/mi^2), sensitive land type road density rated as high (> 3.0 mi/mi^2 of sensitive land types within watershed), 0.9 road crossing/mile of road, 3.7 road crossings for mi^2 of watershed (> 3 considered high), 45% total disturbance from roads and harvest (> 40% considered high), 0% detrimental soil disturbance. Riparian road density rated high (> 3.0 mi. road/mi^2 of riparian area considered high), # of road crossings/mile of stream rated moderate at 2.0 crossing/mile of stream, 53% intact riparian rated as high potential for disturbance (< 70% rated as high).

In 2003, DEQ performed a stream reach assessment at a site 1.5 miles from the mouth (K01THRLC10). The assessor noted the substrate was dominated by fine gravels and sand, and noted some disturbance to fish habitat in the lower portion of the reach and sand deposition as limiting spawning habitat. In addition, the surveyors noted significant sediment sources upstream the site and indications of heavy bedload movement. With the exception of some lateral erosion along farmed areas with limited riparian vegetation, bank erosion was minimal and the riparian vegetation was rated as "sustainable."

In 2008, sediment and habitat assessments were completed at two sites on Therriault Creek. The uppermost site (THR 9-5) was located on private property approximately 4 miles upstream of the confluence with the Tobacco River. Impacts within the reach include historic logging within the riparian area. Current logging was noted in the area though proper BMPs were in place and impacts to the stream were not observed. The stream reach has a potential Rosgen stream type of E4 with a low width/depth ratio and gravel substrate, but the reach is also slightly entrenched in areas resembling a B4a stream type. The reach has a fairly steep slope, poor spawning habitat and marginal pool formation. A few tall eroding banks were observed but most bank erosion was on outside meander bends. Bank erosion sources were cited as logging and natural.

The lowermost full assessment site (THR 14-1) was located on private property approximately 2.5 miles upstream of the confluence with the Tobacco River. At this location, human sediment sources include an undersized failing culvert and historic riparian logging and grazing. Observers noted that new riparian fencing was in place and in good shape. The stream reach is a Rosgen type C4 channel in the upper portion, and resembles an E4 type in the lower section due to a very low width/depth ratio. Aggradation was observed upstream of the failed culvert. Bank erosion at the site was minimal and predominantly limited to outside meander bends. Bank erosion was mostly attributed to natural sources but human sources included rural residences, grazing, and logging.

Comparison to Water Quality Targets

The existing data in comparison to the targets and for Therriault Creek (THR) are summarized in **Table 5-21**. The macroinvertebrate bioassessment data for Therriault Creek is located in **Table 5-22**. All bolded cells represent conditions where target values are not met.

Table 5-21. Existing Sediment-Related Data for Therriault Creek relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count (mean)		Grid Toss (mean)		Channel Form (median)		Instream Habitat			Greenline % Shrub Cover
					% < 6mm	% < 2mm	Riffle % < 6mm	Pool % < 6mm	W/D Ratio	Entrenchment Ratio	Residual Pool Depth (ft)	Pools / Mile	LWD / Mile	
THR 14-1	2008	17.4	C4/E4	B4c/C4	15	**11**	7	3	12.8	2.9	1.5	84	396	**27**
THR 9-5	2008	15.6	B4c/E4	B4c/E4	**19**	8	**13**	7	10.6	2.1	1.2	84	808	60
K01THRLC10	2003	--	--	--	**65**	**49**	--	**--**	**--**	--	--	--	--	--

Values that do not meet the target are in **bold**.

Table 5-22. Macroinvertebrate Bioassessment Data for Therriault Creek

Stream Name	Station ID	Location	Collection Date	Collection Method	MMI	O/E
Therriault Creek	K01THRLC10	1.5 mi upstream from mouth	8/11/03	Kick	71.61	1.08
Therriault Creek	FORTINE03	1.5 mi upstream from mouth	8/14/06	Surber	**49.64**	1.08

Values that do not meet the target are in **bold**.

Summary and TMDL Development Determination

The pebble count in 2003 exceeded both percent fine target values, and although pebble count values were quite a bit less in 2008, site THR 9-5 exceeded the riffle pebble count and grid toss targets for fine sediment < 6mm and THR 14-1 exceeded the riffle pebble count target for fine sediment < 2mm. Both sites met the grid toss fine sediment target for pool spawning habitat. This data suggests that excess fine sediment is accumulating in riffles and potentially impacting the aquatic and fishery beneficial use.

However, because part of each assessment reach is an E channel type, which commonly has higher percentages of fine sediment than B and C channels, it is recommended that the fine sediment targets be re-evaluated in the future to determine if they are attainable for Therriault Creek. Both sites met the channel morphology targets. The riparian shrub target was not met for THR 14-1, but based on a review of site notes and other aspects of the greenline assessment, the low shrub cover value is not a concern because the reach had lots of wetland vegetation stabilizing the streambanks and new riparian fencing in place. All other habitat related targets were met.

Macroinvertebrate data collected in Therriault Creek met both targets values at one site but failed to meet the MMI target value at the other site. Although the corresponding O/E value is well above the target (i.e., 0.80), the burrowing taxa at the site are elevated, indicating fine sediment is likely impairing the macroinvertebrates.

Field observations from 2008 document well-maintained near stream BMPs throughout the lower watershed, and the restoration project completed in 2005 addressed a major sediment source and undoubtedly reduced loading to Therriault Creek. Despite these improvements, field observations and recent data also indicate that Therriault Creek is still recovering from the effects of historic logging and grazing practices. Additional controllable human sediment sources that were identified include roads, residential development, and cropland. Because Therriault Creek is still recovering from historic management practices, significant controllable human sediment sources exist, and because of its sensitivity to disturbance, a sediment TMDL will be prepared for Therriault Creek.

5.4.2.8 Tobacco River
The Tobacco River (MT76D004_010) is listed for sedimentation/siltation on the 2010 303(d) List. In addition, the Tobacco River is also listed for physical substrate habitat alterations. The Tobacco River was originally listed in 1988 based on sedimentation and bank erosion attributed to logging, roads, and agriculture. The Tobacco River extends 14 miles from its formation at the confluence of Grave Creek and Fortine Creek to the mouth, at Lake Koocanusa.

Physical Condition and Sediment Sources
Sediment and habitat assessments were performed at four locations throughout the Tobacco River from its headwaters (confluence of Grave and Fortine Creeks) to the mouth. Of these four locations, two were full assessment reaches and two were bank erosion only assessment reaches. The upper most assessment reach (TOB 1-1) was located on private property just downstream the confluence of Grave Creek and Fortine Creek. This reach was influenced by rural residential development and some minor grazing impacts. The stream reach was a Rosgen C4 stream type, but resembles an F4 in areas due to entrenchment. Aerial imagery shows old channel scars and floodplain deposits within the agriculture area to the south of the assessment reach, suggesting that this portion of the Tobacco River has been channelized, which likely contributed to the entrenchment noted above. The reach assessed was a high energy system, with large substrate, and a minimal number of pools, and poor spawning habitat.

The most downstream assessment site (TOB 2-6) was located just upstream of the Highway 37 bridge on private property. Human impacts within this reach include rural residential encroachment with severely eroded streambanks. Surveyors noted a failing bank erosion and flood control project on one eroding bank. The old railroad grade was on river left of the assessment reach. The bottom of the reach is naturally confined between bedrock on both sides of the river, and the river above the site is relatively unconfined though apparently channelized historically from development in the floodplain. The stream channel is a Rosgen type C4 and F4 in areas due to entrenchment. The river appeared to be aggrading and overwidened in places. Within the reach, surveyors noted multiple transverse bars with high bedload that appears to be partly from the large eroding banks. Riparian vegetation within the reach had been removed in areas and is attributable to historic agriculture and current residential encroachment within the floodplain.

At the two bank erosion sites, streambank erosion is assessed and a qualitative assessment of human impacts is evaluated. The uppermost bank erosion only site (TOB 1-3) was located just downstream of the Tobacco River's confluence with Therriault Creek. This reach is naturally confined against a hillside on river right, while apparently unconfined on river left. That being said, changes in land use within the floodplain have forced the river into its current which has led to channelization. Aerial imagery reveals old channel scars and floodplain deposits within the agriculture area to the south of the assessment reach supporting the prior assertion, and suggesting that entrenchment and bank erosion could be a problem.

The lowermost bank erosion only site (TOB 2-3) was located with the Town of Eureka. The site was located just upstream of the Dewey Avenue bridge. The reach was very confined, with urban impacts to the north and railroad and lumber yard impacts to the south. Lots of riprap exists along the reach to prevent the stream from migrating into its banks. Though confined, surveyors noted that the reach generally has good riffle development, a fair amount of woody debris, and good point bar development, though poor habitat complexity was noted. Salmon were actively spawning in the reach during this assessment. Several tall actively eroding streambanks were observed as well as some slowly eroding banks with good surface protection from cobbles. Bank erosion as attributed to a combination of urban development, roads, and natural sources.

A Master's thesis completed in 2002 reported on stream morphology, riparian conditions, and late summer instream nutrient levels along the Tobacco River, and provided some recommendations for streambank stabilization at one site located approximately one mile downstream the Town of Eureka (Dunn, 2002). During this assessment, Dunn found many large eroding streambanks that appeared to be the result of anthropogenic activities. Sources included cattle grazing and browse of riparian vegetation, channelization and entrenchment from channel manipulations, riparian clearing and failed bank stabilization projects. Accelerated rates of bank erosion were occurring throughout nearly 11% of the study reach, for a total of 422 meters of erosion along 3960 meters of bank. Dunn concluded that the study site was a significant source of human caused sediment and that the site was prime candidate for bank stabilization and riparian restoration.

Though the TMDL process primarily focuses on those activities that are currently impacting the waterbodies in question, it is also important to make note of historic impacts, as they may be still affecting the dimension, pattern and profile of these rivers and streams. In this regard, the Tobacco River has a long history of impacts. Near the turn of the twentieth century the Eureka Lumber Mill was at its earliest stages of production. At that time, logs were floated down the Tobacco during high water. These floats which occurred early in the spring were used to transport hundreds of thousands of logs downstream to the "Big Mill" in Eureka. Historic accounts state that after the first few years, the banks of the Tobacco River were so severely degraded that dams needed to be constructed along the Tobacco in order to produce enough head to float the logs downstream. In 1919, fifty million board feet of timber were floated down the Tobacco River and logs were backed upstream for over 25 miles. The log floats ended in 1924 when the Eureka Mill closed. During this time period, impacts to the geomorphology and aquatic life of the Tobacco River were extensive, and though these activities ended over 85 years ago, the Tobacco River appears to still be in a recovery mode. Impacts often associated with these types of activities include: Channel scour that homogenizes bed substrates, entrenchment of the stream channel and reduction of the river's ability to access its floodplain leading to increased bank erosion, reductions in pool habitat and quality, and major impacts to aquatic macroinvertebrate communities. Though many of the impacts noted above have recovered, others, such as entrenchment and bank erosion, are still prevalent throughout the river's length.

Comparison to Water Quality Targets

The existing data in comparison to the targets for the Tobacco River (TOB) are summarized in **Table 5-23**. The macroinvertebrate bioassessment data for the Tobacco River is located in **Table 5-24**. All bolded cells represent conditions where target values are not met.

Table 5-23. Existing Sediment-Related Data for Tobacco River Relative to Targets

Reach ID	Assessment Year	Mean BFW (ft)	Existing Stream Type	Potential Stream Type	Riffle Pebble Count (mean)		Grid Toss (mean)		Channel Form (median)		Instream Habitat			Greenline % Shrub Cover
					% < 6mm	% < 2mm	Riffle % < 6mm	Pool % < 6mm	W/D Ratio	Entrenchment Ratio	Residual Pool Depth (ft)	Pools / Mile	LWD / Mile	
TOB 2-6	2008	84.7	C4/F4	C4	8	6	1	1	**42.3**	**1.8**	2.6	32	106	62
TOB 1-1	2008	75.5	C4/F4	C4	10	**9**	2	5	31.1	4.0	1.6	16	**90**	**38**

Values that do not meet the target are in **bold**.

Table 5-24. Macroinvertebrate Bioassessment Data for the Tobacco River

Stream Name	Station ID	Location	Collection Date	Collection Method	MMI	O/E
Tobacco River	BKK145	0.3 mi u/s from mouth	8/13/92	Kick	77.40	0.88
Tobacco River	FORTINE02	Near confluence of Fortine and Grave creeks	8/15/06	Surber	68.05	0.89
Tobacco River	FORTINE01	0.5 mi u/s from mouth	8/21/06	Surber	66.41	0.88

Values that do not meet the target are in **bold**.

Summary and TMDL Development Determination

During the 2008 assessments, site TOB 1-1 slightly exceeded the pebble count target for fine sediment < 2mm. Data collected during this effort found that the substrate was predominately cobble sized. The lowermost site (TOB 2-6) did not meet either channel morphology target, which was largely a result of the overwidened sections and entrenched sections. The uppermost site below the confluence of Grave and Fortine Creeks did not meet the targets for LWD or greenline shrub cover. A review of the greenline assessment notes indicates the shrub cover target was not met due to historic grazing, but vegetation is recovering and wetland vegetation was observed in some areas.

Of the three macroinvertebrate samples collected on the Tobacco River, all samples met both target values, indicating the macroinvertebrate communities at those sites are not impaired.

Based on the recent data, several sections of the Tobacco River have recovered from the widespread changes largely associated with historic log drives and have good substrate distribution within riffles, sufficient LWD, and high quality fish spawning and rearing habitat. However, other stressors such as excessive sediment loads from tributaries and channelization, removal of riparian vegetation, and confinement from transportation networks have slowed the system's recovery and contributed to channel entrenchment, streambank instability and erosion, and a reduction in sediment transport capacity. All of these factors are likely limiting the ability of the Tobacco River to fully support fish and aquatic life. Therefore, this information supports the existing 303(d) listings and a sediment TMDL will be written for the Tobacco River.

5.5 TMDL Development Summary

Based on the comparison of existing conditions to water quality targets, eight sediment TMDLs will be developed in the Tobacco TPA. **Table 5-25** summarizes the sediment TMDL development determinations and corresponds to **Table 1-1**, which contains the TMDL development status for listed waterbody segments in the Tobacco TPA on the 2010 303(d) List.

Table 5-25. Summary of TMDL Development Determinations

Stream Segment	Waterbody #	TMDL Development Determination (Y/N)
Deep Creek, headwaters to mouth (Fortine Creek)	MT76D004_080	Y
Edna Creek, headwaters to mouth (Fortine Creek)	MT76D004_030	Y
Fortine Creek, headwaters to mouth (Grave Creek)	MT76D004_020	Y
Lime Creek, headwaters to mouth (Fortine Creek)	MT76D004_050	Y
Sinclair Creek*, confluence of un-named tributary, Lat -114.945 Long 48.908, to mouth (Tobacco River)	MT76D004_091	Y
Swamp Creek, headwaters to mouth (Fortine Creek)	MT76D004_040	Y
Therriault Creek, headwaters to mouth (Tobacco River)	MT76D004_070	Y
Tobacco River, confluence of Grave Creek & Fortine Creek to mouth (Lake Koocanusa)	MT76D004_010	Y

* Sinclair Creek was not on Montana's 2010 303(d) List

5.6 Source Assessment

This section summarizes the assessment approach, current sediment load estimates, and rationale for load reductions within the Tobacco River TPA. Focus is on the below list of four potentially significant sediment source categories and associated controllable human loading associated with each of these sediment source categories.

- streambank erosion
- upland erosion
- roads
- permitted point sources

EPA sediment TMDL development guidance for source assessments states that the basic source assessment procedure includes compiling an inventory of all sources of sediment to the waterbody and using one or more methods to determine the relative magnitude of source loading, focusing on the primary and controllable sources of loading (U.S. Environmental Protection Agency, 1999). Additionally, regulations allow that loadings "may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading" (Water quality planning and management, 40 CFR § 130.2(G)). The source assessments evaluated loading from the primary sediment sources using standard DEQ methods, but the sediment loads presented herein represent relative loading estimates within each source category, and, as no calibration has been conducted, should not be considered as actual loading values. Rather, relative estimates provide the basis for percent reductions in loads that can be accomplished via improved land management practices for each source category. These estimates of percent reduction provide a basis for setting load or wasteload allocations. As better information becomes available and the linkages between loading and instream conditions improve, the loading estimates presented here can be further refined in the future through adaptive management.

For each impaired waterbody segment, sediment loads from each source category were estimated based on field surveys, watershed modeling, and load extrapolation techniques (described below). The results include a mix of sediment sizes, particularly for bank erosion that involves both fine and coarse sediment loading to the receiving water, whereas loads from roads, upland erosion, and permitted point source discharges are predominately fine sediment.

The complete methods and results for source assessments for upland erosion, roads, and streambank erosion are located in **Appendices E, F,** and **G.** The following sections provide a summary of the load assessment results along with the basis for load reductions via improved land management practices. This load reduction basis provides the rationale for the TMDL load and wasteload allocations defined in **Section 5.7**.

5.6.1 Eroding Streambank Sediment Assessment

Streambank erosion was assessed in 2008 at the 18 full assessment reaches discussed in **Section 5.3**, but because the results of the field assessment are extrapolated to the listed-segment watershed scale, an additional 14 reaches were assessed for bank erosion to help obtain a representative dataset of existing loading conditions, causes, and the potential for loading reductions associated with improvements in land management practices. Sediment loading from eroding streambanks was assessed by performing Bank Erosion Hazard Index (BEHI) measurements and evaluating the Near Bank Stress (NBS) (Rosgen, 2006) along monitoring reaches in 2008. BEHI scores were determined at each eroding streambank based on the following parameters: bank height, bankfull height, root depth, root density, bank angle, and surface protection. In addition to BEHI data collection, the source of streambank erosion was evaluated based on observed human-caused disturbances and the surrounding land-use practices based on the following near-stream source categories:

- transportation
- riparian grazing
- cropland
- mining
- silviculture
- irrigation-shifts instream energy
- natural sources
- other

Based on the aerial assessment process (described in **Section 5.3**) in which each assessed stream segment is divided into different reaches, streambank erosion data from each 2008 monitoring site was used to extrapolate to the reach scale. Then, the average value for each unique reach category was applied to unmonitored reaches within the corresponding category to estimate loading associated with bank erosion at the stream segment and watershed scales. The potential for sediment load reduction was estimated as a percent reduction that could be achieved if all eroding streambanks could be reduced to a moderate BEHI score (i.e., moderate risk of erosion). For assessed streambanks already achieving this rate, no reduction was applied. The most appropriate best management practices (BMPs) will vary by site, but streambank stability and erosion rates are largely a factor of the health of vegetation near the stream, and the application of riparian BMPs are anticipated to lower the BEHI scores and result in the estimated reductions. It is acknowledged that a moderate risk of erosion may not be achievable for all eroding banks. This is balanced by the recognition that greater reductions in erosion risk might be achievable for other eroding banks.

For bank erosion, some sources are the result of historical land management activities that are not easily mitigated through changes in current management, and they may be costly to restore and have been irreversibly altered. It is also recognized that it is difficult to capture bank erosion linked to historic channel manipulation or flow modifications from past land management, both of which are concerns throughout the Tobacco watershed given the logging and development history discussed in previous sections of this document. Therefore, although the sediment load associated with bank erosion is presented in separate source categories (e.g., transportation, grazing, cropland), the allocation is presented as a percent reduction expected collectively from human sources. A more detailed description of this assessment can be found in *Streambank Erosion Source Assessment,* which is included as **Appendix E**.

Assessment Summary

Based on the source assessment, streambank erosion contributes an estimated 20,684 tons of sediment per year to the Tobacco River TPA. Sediment loads due to streambank erosion range from 433 tons/year in the Therriault Creek watershed to 10,849 tons per year in the Fortine Creek watershed. For the whole watershed, 74% of the sediment load from streambank erosion is attributed to natural sources (no human impacts), while 26% is attributable to human sources. Significant human related sources of streambank erosion include riparian grazing, riparian clearing, hay production, transportation, and historic logging. **Appendix E** contains additional information about sediment loads from eroding streambanks in the Tobacco River TPA by subwatershed, including all that were assessed. **Table 5-26** provides a summary of the bank erosion loads by each watershed where TMDLs are being developed in this document. **Table 5-26** also includes sediment load reduction information based on the application of best management practices. The load reduction approach and associated assumptions are described in **Appendix E**.

Table 5-26. Bank Erosion Results; Estimated Load Reduction Potential and Resulting Modeled Loads after Application of Best Management Practices

Watershed	Total Bank Erosion Load	Load Reduction Potential (% reduction)	Modeled Load After Application of Best Management Practices (tons/year)
Deep Creek	453	13	396
Edna Creek	452	1	446
Fortine Creek	10,849	7	10,109
Sinclair Creek	1,381	25	1,039
Therriault Creek	433	11	386
Lime Creek	530	8	487
Swamp Creek	1,408	7	1,314
Tobacco River	20,684	8	18,946

Appendix D also provides a comparison of bank erosion loads from the Tobacco TMDL assessment from this project to bank erosion loads from the 2003 Grave Creek TMDL source assessment (Montana

Department of Environmental Quality, 2005). While the result from both source assessments are similar, this points out that loading values can vary based on assessment methodology.

Based on field observations, bank erosion sediment loading in the Tobacco watershed includes a significant percentage of sediment that is larger than the fine sediment category of primary concern regarding most of the target parameters evaluated. This is particularly true in watersheds like Grave Creek where bank erosion in the lower reaches includes a significant portion of cobble size material.

5.6.2 Upland Erosion and Riparian Buffering Capacity

Upland sediment loading due to hillslope erosion was modeled using the Universal Soil Loss Equation (USLE). Sediment delivery to the stream was predicted using a sediment delivery ratio, taking into account riparian buffering. The USLE results are useful for source assessment as well as for determining allocations to human-caused upland erosion. This model provided an estimate of existing sediment loading from upland sources and an estimate of potential sediment loading reductions that could be achieved by applying best management practices (BMPs) in the uplands and in the near stream riparian area. Because the plant canopy and type of tillage practices can influence erosion, potential load reductions were calculated by adjusting factors within the model associated with land management and cropping practices (C-factors). Additional potential load reductions were estimated by improving the sediment trapping efficiency of the riparian buffer. Riparian health was classified as poor, fair, or good per listed waterbody for both right and left banks during the aerial stratification process described in **Section 5.3** and the improved condition with BMPs in place was represented as 75 percent of the riparian habitat in good condition and 25 percent in fair condition. Ground cover values and BMP implementation for both scenarios (i.e., existing and potential reductions) were based on literature values, stakeholder input, and field observations. It is acknowledged that ground cover values and BMP implementation are variable within land use categories throughout the watershed and over time, but due to the scale of the model, values for ground cover were assumed to be consistent throughout each land use category and throughout the year. Additionally, it is important to note that a significant portion of the remaining sediment loads after BMPs in areas with agricultural and/or transitional land-uses is also a component of the "natural upland load", but the assessment methodology did not differentiate between sediment loads with all reasonable BMPs and "natural" loads where there were no human influences.

The sediment load allocation strategy for upland erosion sources provides for a potential decrease in loading through BMPs applied to upland land uses, as well as those land management activities that have the potential to improve the overall heath and buffering capacity of the vegetated riparian buffer. The allocation to these sources includes both present and past influences and is not meant to represent only current management practices; many of the restoration practices that address current land use will reduce pollutant loads that are influenced from historic land uses. A more detailed description of the assessment can be found in **Appendix F**.

Assessment Summary

Based on the source assessment, upland erosion contributes approximately 2,297 tons per year to the Tobacco River TPA. This includes assessed loading from the Grave Creek watershed to the Tobacco River. The assessment indicates that rangeland grazing and hay production within the near stream riparian buffer are the most significant contributors to accelerated upland erosion. Sediment loads due to upland erosion range from 35 tons/year in the Lime Creek sub-watershed to 1,106 tons/year in the Fortine Creek watershed. Since this assessment was conducted at the watershed scale, it is expected that larger watersheds will have greater sediment loads. A significant portion of the sediment load due to upland erosion is contributed by natural sources. **Appendix F** contains additional information about sediment loads from upland erosion in the Tobacco River TPA by subwatershed, including all 6th code HUCs in the TPA. In order to facilitate reporting of the upland sediment loading information following the allocation strategy specific to this source category the data from each sub-watershed located in the appendix was further manipulated by:

- All sources that generate < 1 ton of sediment per year were considered insignificant and were removed;
- Land use categories were lumped into these classes;
    - Forest – Evergreen Forest, Wetlands, Transitional
    - Range – Shrub / Scrub
    - Agricultural – Grassland / Herbaceous, Pasture / Hay, Cultivated Crops
    - Other – Mixed land use
- All sediment loads were rounded to the nearest ton

Table 5-27 below reports the final loading information for those watersheds that will have TMDLs developed for them.

Table 5-27. Existing Upland Sediment Loads by Watershed Incorporating both Upland and Riparian Conditions.

Watershed	Watershed Area (acres)	Estimated Existing Upland Sediment Load (tons/year)	Normalized Upland Sediment Load (tons/year/acre)
Deep Creek	11,803	168	0.0138
Edna Creek	14,502	99	0.0067
Fortine Creek	158,448	1,106	0.0070
Sinclair Creek	7,827	76	0.0096
Therriault Creek	12,937	101	0.0078
Lime Creek	6,148	35	0.0057
Swamp Creek	27,986	252	0.0090
Tobacco River	277,067	2,297	0.0083

Appendix F also provides an evaluation of potential load reduction using land cover improvement BMPs along with riparian improvement BMPs. Total potential load reductions and resulting loads after applying the BMP reductions are summarized in **Table 5-28**. This information can be used as a basis for setting TMDL load allocations.

Table 5-28. Estimated Load Reduction Potential and Resulting Modeled Loads after Application of Best Management Practices

Watershed	Estimated Existing Upland Sediment Load (tons/year)	Estimated Load Reduction Potential (% reduction)	Modeled Load After Application of Best Management Practices (tons/year)
Deep Creek	168	16	141
Edna Creek	99	35	64
Fortine Creek	1,106	30	778
Sinclair Creek	76	37	48
Therriault Creek	101	34	67
Lime Creek	35	29	25
Swamp Creek	252	37	160
Tobacco River	2,297	31	1585

5.6.3 Road Sediment Assessment

5.6.3.1 Erosion from Unpaved Roads

Sediment loading from unpaved roads was assessed using GIS, field data collection, and sediment modeling. Each identified unpaved road crossing and near-stream road segment was assigned attributes for road name, surface type, road ownership, stream name, subwatershed, and landscape type (i.e., mountain, foothill, or valley). Fifty crossings and 10 near-stream parallel segments representing the range of conditions within the watershed were field assessed in 2008, and sediment loading was estimated using the Water Erosion Prediction Project Methodology (WEPP:Road). The average sediment contribution from unpaved road crossings and near-stream road segments were extrapolated to all unpaved roads in the watershed based on landscape type. To address sediment from unpaved roads in the TMDLs and allocations that follow in **Section 5.7**, the WEPP:Roads analysis was also run using BMPs to reduce the road contributing length to 200 feet. The 200-foot BMP scenario is used in this document as a general approximation of achievable modeled loading reduction to help develop the road crossing allocations. The intent is to ensure that all road crossings have the appropriate BMPs in place to protect water quality via reduced sediment loading. Other potential BMPs include the installation of full structural BMPs at existing road crossings (drive through dips, culvert drains, settling basins, silt fence, etc), road surface improvement, reduction in road traffic levels (seasonal or permanent road closures), and timely road maintenance to reduce surface rutting. A more detailed description of this assessment can be found in **Appendix G**.

Assessment Summary

Based on the source assessment, unpaved roads are contributing 98 tons of sediment per year to the Tobacco River watershed. This includes 78 tons from unpaved road crossings and 9 tons per year from parallel unpaved road segments for the Tobacco TMDL planning area; plus an additional 11 tons per year from unpaved road crossings and parallel segments in the Grave Creek watershed. Sediment loads range from < 1 ton/year in the Sinclair Creek watershed to 72.4 tons/year in the Fortine Creek watershed. Factors influencing sediment loads from unpaved roads at the watershed scale include the overall road density within the watershed, watershed size, and the configuration of the road network, along with factors related to road construction and maintenance. **Table 5-29** contains annual sediment loads from unpaved roads (crossings & parallel segments) from the watersheds where TMDLs are developed within this document. **Table 5-29** also includes the percent load reduction by watershed based on the contributing road length BMP scenario which is further defined within **Appendix G**.

When evaluated by ownership for the Tobacco River watershed, the load per crossing after extrapolation was about the same for federal and private crossings. However, because of the higher number of federal crossings, the total load breakdown was about 51 tons/year for federal crossings and 23 tons/year for private crossings. The resulting reduction in sediment loading, when extrapolated by ownership and landscape type, was also similar for road crossing ownership, with a resulting 56% reduction for federal roads and a 58% reduction for private roads. Only one state road crossing was evaluated and therefore state roads are not included in this comparison.

Table 5-29. Annual Sediment Load (tons/year) from Unpaved Roads (Crossings + Parallel Segments) within the Tobacco River Watershed.

Watershed	Total Load (tons/year)	Percent Load Reduction After BMP Application	Total Sediment Load After BMP Application
Deep Creek	**2.4**	**50%**	**1.2**
Edna Creek	**9.3**	**57%**	**4.0**
Fortine Creek	**74.1**	**56%**	**32.6**
Lime Creek	**3.9**	**56%**	**1.7**
Sinclair Creek	**0.7**	**57%**	**0.3**
Swamp Creek	**9.1**	**57%**	**3.9**
Therriault Creek	**2.9**	**52%**	**1.4**
Tobacco River Watershed	**98**	**57%**	**42.1**

5.6.3.2 Road Sand Contribution and Assessment Summary
An estimate of road sand contribution from paved road crossings and paved parallel segments is provided in **Appendix G**. The final load determination is based on state and county application rates and an assumed delivery percentage based on similar analyses from previous TMDL documents. The estimated road sand load throughout the watershed was 16 tons/year prior to 2008 and 11 tons/year after 2008. A reduction analysis for this 11 tons/year is not pursued for allocation purposes for the reasons identified below.

- Road sanding plays an important driving safety role
- The sediment load is significantly low in comparison to loads from unpaved roads
- Significant application rate reductions have already been achieved for state roadways by the transition from road sand to road salt.

5.6.3.3 Culvert Failure and Fish Passage Analysis
Undersized or improperly installed culverts may be a chronic source of sediment to streams or a large acute source during failure, and they may also be passage barriers to fish. Therefore, during the roads assessment, the flow capacity and potential to be a fish passage barrier was evaluated for a subset of culverts. The flow capacity culvert analysis was performed on 47 culverts and incorporated bankfull width measurements taken upstream of each culvert to determine the stream discharge associated with different flood frequencies (e.g., 2, 5, 10, 25, 50, and 100 year) and measurements for each culvert to estimate its capacity and amount of fill material.

Though culvert failure represents a potential load of sediment to streams, a yearly load estimate is not provided due to the uncertainty regarding estimating the timing of such failures and a lack of monitoring information to track the occurrence of these failures.

Fish passage assessments were performed on 8 culverts. The assessment was based on the methodology defined in **Appendix G**, which is geared toward assessing passage for juvenile salmonids.

Considerations for the assessment include streamflow, the culvert slope, culvert perch/outlet drop, culvert blockage, and constriction ratio (i.e., culvert width to bankfull width). The assessment is intended to be a coarse level evaluation of fish passage that quickly identifies culverts that are likely fish passage barriers and those that need a more in-depth analysis. Culverts with fish passage concerns may have elevated road failure concerns since fish passage is often linked to undersized culvert design.

Assessment Summary

More than half of culverts (57%) were estimated to pass the Q100 event. However, there were 18 culverts (38%) that did not pass the Q25 design flow. For the federal crossings, 69% passed the Q25 and 66% passed the Q100, whereas only 36% of the private crossings passed the Q25 and only 27% passed the Q100. Many of the private crossings did not even pass the 2, 5 or 10 year flow events, indicating a significant culvert failure risk for this category of culverts. On the other hand, it appears that the Forest Service (federal) crossings are being managed in a manner consistent with the Inland Native Fish Strategy (U.S. Department of Agriculture, Forest Service, 1995a) recommendation that as old culverts are replaced, new culverts should be designed to pass the 100-year flow event.

For the fish passage assessment, 4 out of 8 culverts were determined to pose a significant passage risk to juvenile fish at all flows and 4 were determined to need additional analysis.

5.6.4 Point Sources

As of January 1, 2011, permitted point sources within the Tobacco River watershed consist of:

- Eureka Sewage Treatment Facility (MTG580032),
- Timberline Ready Mix (MTR300259), and
- Six general permits for construction stormwater

5.6.4.1 Eureka Sewage Treatment Facility (MTG580032)

The Eureka Sewage Treatment Facility is a 3-celled aerated wastewater treatment lagoon system with a design capacity of 0.35 million gallons per day (MGD). The facility is authorized under the General Permit for Domestic Sewage Treatment Lagoons (MTG580000), which has a 7-day average total suspended solids (TSS) concentration limit of 135 mg/L and a 30-day average TSS concentration limit of 100 mg/L. Like most wastewater discharge, the suspended solids in the effluent are likely predominantly organic matter and not sediment. According to the permit file, the facility does batch discharges and conducts monitoring prior to discharging. Based on Discharge Monitoring Reports submitted by the facility, 29 TSS samples were collected from 2001 through January 2011 and none exceeded 100 mg/L. The highest concentration was 98 mg/L in 2002 but all other samples were equal or less than 25 mg/L. A conservative calculation of the existing load was made by assuming an average daily discharge of 0.25 mgd, which is the maximum measured discharge in the permit file, at a TSS concentration of 25 mg/L. This would result in an annual load of 9.5 tons.

The maximum allowable permit values can be used to evaluate impact to the Tobacco River by evaluating the potential increase in TSS loading to Tobacco River from the Eureka discharge. Based on unpublished water quality chemistry and flow data collected by DEQ in 2008, a typical low flow for the Tobacco River is about 50 cfs, and a typical TSS value during low flow is about 1 mg/l or less. The Eureka facility design capacity discharge of 0.35 MGD is approximately 0.5 cfs. If the Eureka facility was discharging with a TSS concentration of 135 mg/l into the Tobacco River when the Tobacco River was flowing at 50 cfs, the result would be an increase in TSS concentration in the Tobacco River from 1 mg/l to 2.3 mg/l. Although this represents more than a doubling of the TSS concentration, 2.3 mg/l represents an acceptably low level that is not expected to cause harm to aquatic life (Newcombe and Jensen, 1996) nor is it expected to result in aesthetic concerns.

5.6.4.2 Timberline Ready Mix (MTR300259)

The Timberline Ready Mix facility is authorized under the General Permit for Storm Water Discharges Associated with Mining and with Oil and Gas Activities (MTR300000). The permit (MTR300259) includes a Storm Water Pollution Prevention Plan (SWPPP) and requires biannual reporting of discharge monitoring data. The SWPPP sets forth the procedures, methods, and equipment used to prevent the pollution of stormwater discharges from the facility. In addition, this SWPPP describes general practices used to reduce pollutants in stormwater discharges. DEQ conducted an inspection of the 12.3 acre site in May 2010 and concluded the SWPPP was being followed. According to Attachment B (Monitoring Parameter Benchmark Concentrations) within the general storm water permit, the benchmark value for TSS is 100 mg/l. The facility is designed to capture a minimum of a 2-year one hour storm as part of their SWPPP. There has been no measurable offsite runoff according to the facility operator. Therefore, the existing annual sediment load is likely zero tons or very close to no loading during most years with normal or average precipitation events.

To provide a numeric estimate of the potential yearly sediment load to the Tobacco River from the Timberline Ready Mix, the Soil Conservation Service curve number (CN) methodology (U.S. Department of Agriculture, Soil Conservation Service,1972) was used to relate precipitation events to runoff. Because infiltration capacity varies as a function of landcover condition and soil type, the CN equation presents a way to relate precipitation to rainfall excess or runoff. Precipitation-runoff estimates for this calculation assume that no run-on from upgradient contributing areas occurs and also do not account for rain-on-snow or other precipitation events which may increase water availability. Necessary model parameters were derived from information in the site permit, and a composite curve number of 61 was used in the analysis based on the various landcover types at the site (e.g., paved areas/buildings, gravel, and grass/rangeland) and hydrologic B soil (which was verified in STATSGO). No efforts were made to validate any of the information presented in the permit file.

Based on application of the CN procedure, site runoff does not occur until 1.26 inches of precipitation is received for a given precipitation event. Based on the lack of site runoff (and no resulting Discharge Monitoring Report data), this seems like a reasonable estimate. Runoff volumes were modified to reflect the 200 ft^3 swale mentioned in the permit file. As shown in **Table 5-30**, site runoff was determined for precipitation depth intervals ranging from 1.26 - 3 inches. For intermediate values, the equation of the line can be used by as follows to determine the runoff volume:

Runoff volume (cfs) = $-0.011x^3 + 0.1482x^2 - 0.318x + 0.1873$
x = Precipitation (inches)

As shown in the equation below, the potential daily load was calculated based on the computed site runoff volumes and the site runoff target concentration. The target concentration is based on the 100 mg TSS/L benchmark value provided in the general permit. Because runoff should not be generated from the site until 1.26 inches of precipitation, the load estimate is set = 0 until precipitation equals 1.26 inches or more for a given event. In a review of precipitation data for the Eureka Ranger Station, only about 9 days with precipitation greater than 1.26 inches have been recorded since 1960, with no daily precipitation greater than 2 inches. The potential loads at different precipitation events are included in **Table 5-30** and **Figure 5-4**. A conservatively high yearly load estimate can be based on two 2-inch precipitation events per year, which would result in a load of about 60 lbs or 0.03 tons. This is a very

small load that would rarely occur, if ever, as long as the BMPs identified in the permit are maintained consistent with this analysis.
Daily Load Estimate = Target Concentration (mg/L) * Runoff Volume (cfs) * 5.4 conversion factor

Table 5-30. Estimated Timberline Ready Mix site runoff for precipitation up to 3 inches

Precipitation (in)	Runoff Volume (cfs)	Load (lbs/day)
<1.26	0	0.00
1.50	0.002	3.54
1.75	0.016	13.94
2.00	0.039	30.47
2.25	0.068	52.49
2.50	0.104	79.45
2.75	0.146	110.89
3.00	0.194	146.37

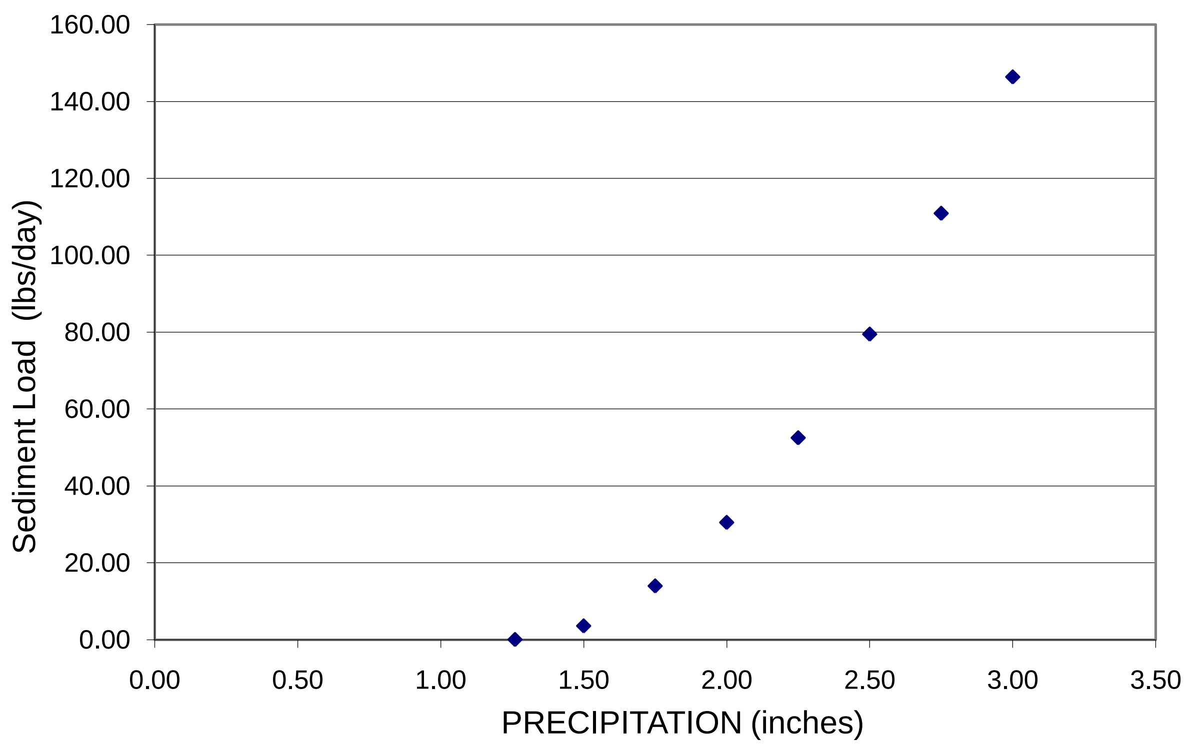

Figure 5-4. Sediment load as TSS with different amounts of precipitation

5.6.4.3 Construction Storm Water Permits

All construction storm water permits were authorized under General Permit MTR100000. As of January 1, 2011 there were six of these permits within the Tobacco TMDL planning area. One of the permits is for a construction project in the Sinclair Creek watershed and the remaining five permits are for construction projects within the Tobacco River watershed in the vicinity of Eureka. Because TMDLs are allocated to the watershed scale, all permitted construction project loading within the Tobacco River watershed will be evaluated cumulatively to facilitate development of a composite wasteload allocation. Collectively, these areas of severe ground disturbance have the potential to be significant sediment sources if proper BMPs are not implemented and maintained.

Each permittee is required to develop a SWPPP that identifies the stormwater BMPs that will be in place during construction. Prior to permit termination, disturbed areas are required to have a vegetative density equal to or greater than 70 percent of the pre-disturbed level (or an equivalent permanent method of erosion prevention). Inspection and maintenance of BMPs is required, and although Montana storm water regulations provide the authority to require stormwater monitoring, water quality sampling is typically not required (Heckenberger, Brian, personal communication 2009).

To assess the disturbed acreage associated with construction storm water permits, each permit file was evaluated. The construction project in the Sinclair Creek watershed was anticipated to disturb 3 acres and the other permitted projects were anticipated to disturb approximately 64 acres. Most of the disturbance (i.e., 40 acres) is associated with a golf course (MTR102204) in the Indian Creek drainage (Indian Creek flows into the Tobacco River). The permit applicant noted that no site runoff was anticipated because of swales and detention ponds on-site. BMPs at other sites include settling basins, straw bales, silt fences, and re-vegetating with a NRCS seed mix.

Two approaches were used to estimate sediment loading from permitted construction sites. The first approach provides an estimate of the sediment loads if inadequate BMPs were in place. The second approach then provides an estimate of the sediment loads with BMPs in place, consistent with storm water construction permit expectations. Loads from both approaches were derived using the output from the upland erosion assessment (**Section 5.3.2** and **Appendix F**). Construction sites have the potential to have C-factors ranging from 0.3 to 1 (Toy and Foster, 1998; Pudasaini, et al., 2004; Sinha and Labi, 2007), with variability associated with soil type and slope, stage of construction, and level of BMP implementation. To estimate impacts from a site with inadequate BMPs, the existing annual erosion rate normalized per acre for the Tobacco River watershed for cultivated crops was tripled to represent construction sites with some ground cover but inadequate BMP implementation (i.e., approximate C-factor = 0.72), resulting in an erosion rate of 0.06 tons/acre/year. This value is then multiplied by the disturbed acreage associated with construction storm water permits, resulting in 0.18 tons/year (0.06 * 3 acres = 0.18) for the Sinclair Creek watershed and about 4.0 tons for the Tobacco River watershed (0.06 * 64 acres = 3.8).

To estimate impacts from these same sites with BMPs in place, the loading rate associated with implementation of upland and riparian BMPs from the cultivated crops category used in **Appendix F** was used as an equivalent condition. This loading rate is equal to 0.013 tons/acre/year and equates to a C-factor of 0.013, representing approximately 80 percent groundcover. This loading rate is then multiplied by the disturbed acreage resulting in a load of 0.04 tons/year for the Sinclair Creek watershed and 0.83 tons/year for the Tobacco River watershed. These lower values represent the estimated existing loads from permitted construction sites based on the assumption that appropriate BMPs are in place and being properly maintained. The above analysis resulted in an approximate 80% reduction in sediment loading with BMPs, and thus provides an example of how BMPs required under storm water permits can result in significantly reduced sediment loading to a waterbody.

5.6.5 Source Assessment Summary

The estimated annual sediment load from all identified sources throughout the Tobacco River Watershed is 23,101 tons. Each source category has different seasonal loading rates, and the relative percentage of the total load from each source category does not necessarily indicate its importance as a loading source. Instead, due to the uncalibrated nature of the source assessment work and the unique uncertainties involved with each source assessment category, the intention is to separately evaluate source impacts within each assessment category (e.g., bank erosion, upland erosion, roads). Results for each source assessment category provide an adequate tool to focus waters quality restoration activities in the Tobacco TMDL planning area by indicating the relative contribution of different subwatersheds or landcover types for that source category and the percent loading reductions that can be achieved with the implementation of improved management practices (**Appendices E**, **F**, and **G**).

5.7 Sediment TMDLs and Allocations

This section is organized by the following topics:

- Application of Percent Reduction and Yearly Load Approaches
- Development of Sediment Allocations by Source Categories
- Allocations and TMDLs for Each Stream
- Meeting the Intent of TMDL Allocations

5.7.1 Application of Percent Reduction and Yearly Load Approaches

The sediment TMDLs for the Tobacco River TPA will be based on a percent reduction approach discussed in **Section 4.** This approach will apply to the loading allocated among sources as well as each individual waterbody TMDLs. An implicit margin of safety will be applied as further discussed in **Section 5.8**. (Cover, et al., 2008) observed a correlation between sediment supply and instream measurements of fine sediment in riffles and pools; it is assumed that a decrease in sediment supply, particularly fine sediment, will correspond to a decrease in the percent fine sediment deposition within the streams of interest and result in attainment of the sediment related water quality standards. A percent-reduction approach is preferable because there is no numeric standard for sediment to calculate th**e** allowable load and because of the uncertainty associated with the loads derived from the source assessment (which are used to establish the TMDL), particularly when comparing different load categories such as road crossings to bank erosion. Additionally, the percent-reduction TMDL approach is more applicable for restoration planning and sediment TMDL implementation because this approach helps focus on implementing water quality improvement best practices (i.e., BMPs), versus focusing on uncertain loading values.

An annual expression of the TMDLs was determined as the most appropriate timescale because sediment generally has a cumulative effect on aquatic life or other designated uses, and all sources in the watershed are associated with periodic loading. Each sediment TMDL is stated as an overall percent reduction of the average annual sediment load that can be achieved after summing the individual annual source allocations and dividing them by the existing annual total load. EPA encourages TMDLs to be expressed in the most applicable timescale but also requires TMDLs to be presented as daily loads (Grumbles, B., personal communication 2006). Daily loads are provided in **Appendix H**.

5.7.2 Development of Sediment Allocations by Source Categories

The percent-reduction allocations are based on the modeled BMP scenarios for each major source type (e.g., streambank erosion, upland erosion, roads and permitted point sources). These BMP scenarios are discussed within **Section 5.6** and associated appendices, and reflect reasonable reductions as determined from literature, agency and industry documentation of BMP effectiveness, and field assessments. Sediment loading reductions can be achieved through a combination of BMPs, and the most appropriate BMPs will vary by site. Sediment loading was evaluated at the watershed scale and associated sediment reductions are also applied at the watershed scale based on the fact that the many of the sources deliver sediment to tributaries that then deliver this sediment load to the impaired waterbodies.

Progress towards TMDL and individual allocation achievement can be gauged by adherence to point source permits, BMP implementation for nonpoint sources, and improvement in or attainment of water quality targets defined in **Section 5.4**. Any effort to calculate loads and percent reductions for purposes of comparison to TMDLs and allocations in this document should be accomplished via the same methodology and/or models used to develop the loads and percent reductions presented within this document.

The following subsections discuss specific allocation details and rationale for each sediment source category.

5.7.2.1 Streambank Erosion

Sediment loads associated with bank erosion were identified by separate source categories (e.g., transportation, grazing, natural) in **Appendix E**. Because of the inherent uncertainty in extrapolating this level of detail to the watershed scale, and also because of uncertainty regarding impacts from historical land management activity, all human caused sources of bank erosion were combined for the purpose of determining the potential sediment load reductions. The reduction approach applied in **Appendix E** assumed that, on average, the application of BMPs along streams could reduce human caused bank erosion by 33%. Because this reduction is only applied to the human caused portion of bank erosion, estimated at 26% for the Tobacco watershed, the percent reductions in total bank erosion loading is significantly lower for each stream of interest depending on the extent of human-caused versus natural (or non-human caused) streambank loading within each watershed.

Streambank stability and erosion rates are largely a factor of the health of vegetation near the stream, and the reduction in bank erosion risk and sediment loading is expected to be achieved by applying BMPs within the riparian zone. These riparian protection BMPs are further defined and discussed within **Section 6**.

5.7.2.2 Upland Erosion

Allocations for upland sediment sources were derived by modeling the reduction in sediment loads that can occur via upland erosion prevention BMPs such as increasing ground cover, and combining these reductions with reduced sediment transport that could be achieved via BMPs to improve riparian and stream buffering conditions. No reductions were allocated to natural sources, which are a significant portion of all upland land use categories, especially the “forest” category.

The load reductions from “agriculture,” “range” and “other” land use categories include a combination of increased application of upland erosion prevention and riparian health improvement BMPs. No reduction from upland erosion prevention BMPs is applied the “forest” land use category based on the assumption that logging or silviculture activities will continue on public and private forest land within the watershed, and these activities will be in adherence to Forestry BMPs for Montana (Montana State University, Extension Service, 2001) and the Montana Streamside Management Zone (SMZ) law (77-5-301 through 307 MCA). A percent reduction is applied to the “forest” category based on riparian and stream buffering improvements over time since grazing and historical riparian harvest have impacted riparian health and stream buffering capacity in many locations. Because of the application of SMZ law in recent years, most of the action necessary to eventually meet the "forest" portion of the upland erosion allocation has been implemented.

The allocation to upland sources includes application of BMPs to present land use activities as well as recovery from past land use influences such as riparian harvest. For all upland sources, the largest percent reduction is achieved via riparian improvements. Upland erosion and riparian improvement BMPs are further defined and discussed in **Section 6**.

5.7.2.3 Roads

Roads allocations are addressed by different sediment loading categories including erosion from unpaved crossings and unpaved parallel segments, road sand application, and road culvert or road crossing failure from flood events.

5.7.2.3.1 Unpaved Roads (Crossings and Parallel Segments)

The percent reduction allocation for unpaved roads is derived from modeling the reduction in road contributing length for those roads where the contributing erosion length was greater than 200 feet. The 200-foot BMP scenario is used in this document as a general approximation of achievable modeled loading reduction to help develop the road crossing allocations; at some locations a shorter contributing length can be obtained via BMP application, and at other locations it may not be feasible. The intent is to ensure that all road crossings have the appropriate BMPs in place to protect water quality via reduced sediment loading and to eliminate the discrete conveyance of sediment loads to streams from the lack of erosion prevention BMPs. Other potential BMPs include the installation of full structural BMPs at existing road crossings (drive through dips, culvert drains, settling basins, silt fence, etc), road surface improvement, reduction in road traffic levels (seasonal or permanent road closures), and timely road maintenance to reduce surface rutting. A more detailed description of the road assessment and reduction analysis can in **Appendix G**.

The unpaved road allocation can be met by incorporating and documenting that all road crossings and parallel segments with potential sediment delivery to streams have the appropriate BMPs in place. Routine maintenance of the BMPs is also necessary to ensure that sediment loading remains consistent with the intent of the allocations. At some locations, road closure or abandonment alone may be appropriate and, due to very low erosion potential linked to native vegetation growth on the road surface, additional BMPs may not be necessary.

Although the **Appendix G** analysis evaluated roads by ownership (private, federal, state), allocations were not apportioned between ownership given the similarities in percent reductions. For example, when extrapolated by ownership and landscape type, the resulting reduction in sediment based on the 200-foot BMP application resulted in a 56% reduction for federal roads and a 58% reduction for private roads. Only one state road crossing was evaluated and therefore state roads are not included in this comparison. Nevertheless, road owners within any ownership category can demonstrate that they are meeting the allocation via application, documentation, and maintenance of the appropriate BMPs at road crossings and parallel segments.

5.7.2.3.2 Road Sanding

An estimate of road sand contribution from paved road crossings and paved parallel segments is provided in **Appendix G**. A reduction analysis is not pursued for allocation purposes for the reasons identified below.

- Road sanding plays an important driving safety role

- The sediment load is significantly low in comparison to loads from unpaved roads
- Significant application rate reductions have already been achieved for state roadways by the transition from road sand to road salt.

The resulting road sand load estimate of 11 tons/year is applied to the Tobacco River versus the individual tributaries because of the small load and variable application of the road sand throughout the watershed. In essence, the load allocation for the Tobacco River and any tributaries with road sanding is no increased loading unless the increase represents an important safety precaution and any new paved road design incorporates sediment delivery BMPs where practical.

5.7.2.3.3 Road Crossing Culverts

Though culvert failure represents a potential load of sediment to streams, a yearly load was not estimated due to its sporadic nature and uncertainty regarding estimating the timing of such failures. A common BMP for culverts is designing them to accommodate the 25-year storm event; this design capacity is specified as a minimum in both the Montana stream permitting guidance for conservation district supervisors and others, and Forestry BMPs for Montana (Montana State University, Extension Service, 2001), and it is typically the minimum used by the USFS. However, other considerations such as fish passage, the potential for large debris loads, and the level of development and road density upstream of the culvert or within the watershed of interest should also be taken into consideration during culvert installation and replacement, and may necessitate the need for a larger culvert. For instance, the USFS typically designs culverts to pass the 100-year event and be suitable for fish and aquatic organism passage on fish bearing streams (U.S. Department of Agriculture, Forest Service, 1995a).

The individual or cumulative impacts from historic culvert failures may be contributing to the existing water quality impairment conditions, and future failures could lead to sediment impairment problems not identified or quantified during the 2008 assessment work. Therefore, a watershed scale load allocation is developed for culverts at road crossings. The culvert allocation is no loading from culverts as a result of being undersized, improperly installed, or inadequately maintained. At a minimum, culverts should meet the 25-year event. Meeting the 100-year event is recommended for fish-bearing streams or those watersheds with a high road density, an existing high number of undersized culverts (e.g., those that cannot pass a 25-year or smaller event), or high level of road and impervious surface development upstream. Furthermore, new crossings and culvert replacements must be completed in a manner that allows for fish passage on fish bearing streams unless the Montana Fish Wildlife and Parks and/or the US Fish and Wildlife Service determines that prevention of fish passage is desirable for native species protection.

Upgrading culverts to meet this allocation is an important sediment reduction and water quality improvement goal because a large flow event could lead to significant sediment loading based on the large percentage of culverts that cannot pass a 25-year event per the **Appendix G** analysis. In fact, many culverts throughout the watershed do not appear large enough to even pass flows as common as 2-year, 5-year and 10-year events, particularly for the privately owned crossings.

5.7.2.4 Permitted Point Sources

There are several Montana Pollutant Discharge Elimination System (MPDES) permitted point sources that can contribute sediment loading to streams in the Tobacco watershed. These include a wastewater treatment lagoon permit for the Eureka Sewage Treatment Facility (permit number MTG580032) that discharges into the Tobacco River; an industrial storm water permit for Timberline Ready Mix (permit number MTR300259) that is within the Tobacco River watershed near Eureka; and 6 general permits for construction storm water as of January 1, 2011; including one large acreage within Sinclair Creek watershed and the remaining five within the Tobacco River watershed near Eureka. The following subsections define the rationale used to develop the wasteload allocations (WLAs) for these permits.

5.7.2.4.1 Eureka Sewage Treatment Facility

One option for developing the WLA for the Eureka Sewage Treatment facility (**WLA_{EUREKA}**) is to base the WLA on the current load limit in its permit. This can be calculated using the facility's existing nondegradation permit limit (Montana Department of Environmental Quality, Permitting and Compliance Division,1999) which is based on a discharge of 0.225 mgd (0.35 cfs) and a 30-day average TSS permit concentration limit of 100 mg/L. This equates to 188 lbs/day, or 34.2 tons/year. The potential impact from the permitted discharge was evaluated in **Section 5.6** where it was determined that a higher load than this permit load would not cause a negative impact on Tobacco River water quality.

Therefore, the 34.2 tons/year load based on the existing permit is an acceptable value to use as the **WLA_{EUREKA}** and it only applies to the Tobacco River TMDL.

5.7.2.4.2 Timberline Ready Mix Industrial Storm Water Permit

The permit for Timberline Ready Mix is an industrial storm water permit, and thus, the facility does not have a regular discharge. The WLA for Timberline Ready Mix is developed using a loading analysis based on existing BMPs, land cover, precipitation, and runoff modeling that was performed as part of the facility's source assessment in **Section 5.6.4**. The analysis resulted in conservatively high load estimate of 0.03 tons/year (60 lbs/year). This is an acceptable loading level that will be used to represent the numeric wasteload allocation (**WLA_{TRM}**) for the Timberline Ready Mix facility.

The WLA_{TRM} only applies to the Tobacco River TMDL. The WLA is provided because it is a requirement for permitted point sources (of the pollutant category of concern) but is not intended to add an additional permit load limit requirement; instead it is assumed that the **WLA_{TRM}** will be met by adherence to the permit requirements, which include a SWPPP with numerous BMPs. Because of the very small load from this site, it is assumed that future industrial facilities located anywhere in the Tobacco River watershed will have insignificant loading to any impaired stream as long as similarly protective BMPs are incorporated into each storm water permit.

5.7.2.4.3 Construction Storm Water Permits

The loading estimate (**Section 5.6.4.3**) for permitted construction stormwater sources is based on the upland erosion assessment with appropriate BMPs in place. For the Sinclair Creek watershed, the construction load estimate was 0.04 tons/year based on one permitted site with 3 acres of disturbance. For the Tobacco River watershed, the construction load estimate was 0.83 tons/year based on 6 permitted sites with 64 acres of disturbance. These values are used to develop the construction stormwater WLAs.

Individual WLAs are not provided for each construction site; instead composite construction stormwater WLAs are provided for each stream consistent with EPA guidance (U.S. Environmental Protection Agency, 2008). Since the current number of permits and amount of disturbed acreage represents a snapshot in time, the composite WLA is based on a conservative approach of assuming an increase in permitted construction sites and associated disturbed acreage with BMPs in place; up to 50 acres of disturbance in the Sinclair Creek watershed and up to 400 acres of disturbance in the Tobacco River watershed. This results in a composite WLA equal to 0.7 tons/year for the Sinclair Creek watershed, and a composite WLA equal to 5.3 tons/year for the Tobacco River watershed. These WLAs are intended to address existing and future permits. The WLA is provided because it is a requirement for permitted point sources (of the pollutant category of concern) but is not intended to add load limits to the permit; it is assumed that the WLA will be met by adherence to the General Permit requirements (MTR100000), which include a SWPPP with numerous BMPs and site stabilization before a permit can be terminated. If disturbed acreages exceed the amount used to calculate the WLA, the intent of the allocation may be met by adhering to permit requirements, including SWPPP development and implementation.

The Tobacco River composite WLA can be further apportioned among the impaired streams with sediment TMDLs, providing allowance for future growth in construction permits throughout the watershed as long as the each site owner develops and follows a SWPPP consistent with General Permit requirements. It is estimated that at any one time construction within most drainages would have a small load consistent with the Sinclair Creek construction stormwater composite WLA.

5.7.3 Allocations and TMDLs for Each Stream

The following subsections present of the existing quantified sediment loads, allocations and TMDL for each waterbody.

5.7.3.1 Deep Creek

Deep Creek was listed as impaired due to sedimentation/siltation on the 2010 303(d) List. Sediment sources assessed and quantified within the Deep Creek watershed include roads, streambank erosion, and upland erosion. Human sources of sediment to Deep Creek identified during this assessment include roads/transportation, grazing, cropping, silviculture and “other,” which refers to channel obstructions from historic mining.

The current annual sediment load from the assessed sources is estimated at 623 tons/year (**Table 5-31**). By applying BMPs, this sediment load to the Deep Creek watershed could be reduced to 538 tons/year. To achieve this reduction, a 50% sediment load reduction is allocated to unpaved roads. This reduction can be accomplished via application of appropriate road BMPs. A 13% reduction is allocated to streambank erosion, which equates to a 33% reduction in the human caused portion of the streambank erosion achieved primarily through improved riparian conditions along streams. Sediment loading sources linked to upland or hillslope erosion are allocated a 16% reduction. Upland erosion reductions are primarily achieved through the application of riparian BMPs or similar buffers to reduce the transport of eroded material to streams, although some reductions can also be achieved via erosion prevention BMPs in upland areas.

The sediment TMDL for Deep Creek is expressed as a 14% reduction in the total average annual sediment load.

Deep Creek also has a habitat alteration type of impairment specifically defined as an *alteration in streamside or littoral vegetative covers*. This impairment cause is not a pollutant and does not require TMDL development. The solutions to this habitat problem are included within the water quality protection and improvement activities that must be pursued to meet the Deep Creek sediment TMDL and associated allocations. Therefore, the Deep Creek sediment TMDL addresses both the sediment impairment as well as this habitat alteration impairment.

Table 5-31. Quantified Sediment Loads, Allocations and TMDL for Deep Creek*

Sediment Sources		Current Estimated Load (Tons/Year)**	Potential Estimated Load BMPs (Tons/Year)**	Sediment Load Allocations (% reduction)**
Roads	**Unpaved Roads Total**	**2**	**1**	**50%**
Streambank Erosion	Human Caused	174	117	33%
	Natural Background	279	279	0%
	Total	**453**	**396**	**13%**
Upland Sediment Sources	Forest	133	115	14%
	Range	23	19	14%
	Agriculture	7	4	44%
	Total	**168**	**141**	**16%**
Total Sediment Load		**623**	**538**	**TMDL = 14% Load Reduction**

* In addition to the quantified allocations, allocations developed at the watershed scale for culverts, road sanding, and storm water permits also apply as defined within **Sections 5.7.2.3** and **5.7.3.4**.
Sediment loads were rounded to the nearest whole number, and therefore they do not exactly match the numbers presented in the appendices and within **Section 5.6. The percent reduction values are intended to match the values presented in **Section 5.6** and related appendices.

5.7.3.2 Edna Creek

Edna Creek was listed as impaired due to sedimentation/siltation on the 2010 303(d) List. Sediment sources assessed and quantified within the Edna Creek watershed include roads, streambank erosion, and upland erosion. Human sources of sediment identified during this assessment include roads/transportation, riparian clearing, and hay production.

The current annual sediment load from the assessed sources is estimated at 560 tons/year (**Table 5-32**). By applying BMPs, this sediment load to the Edna Creek watershed could be reduced to 514 tons/year. To achieve this reduction, a 57% sediment load reduction is allocated to unpaved roads. This reduction can be accomplished via application of appropriate road BMPs. A 1% reduction is allocated to streambank erosion, which equates to a 33% reduction in the human caused portion of the streambank erosion achieved primarily through improved riparian conditions along streams. Sediment loading sources linked to upland or hillslope erosion are allocated a 35% reduction. Upland erosion reductions are primarily achieved through the application of riparian BMPs or similar buffers to reduce the transport of eroded material to streams, although some reductions can also be achieved via erosion prevention BMPs in upland areas.

The sediment TMDL for Edna Creek is expressed as an 8% reduction in the total average annual sediment load.

Table 5-32. Quantified Sediment Loads, Allocations and TMDL for Edna Creek*

Sediment Sources		Current Estimated Load (Tons/Year)**	Potential Estimated Load BMPs (Tons/Year)**	Sediment Load Allocations (% reduction)**
Roads	**Unpaved Roads Total**	**9**	**4**	**57%**
Streambank Erosion	Human Caused	19	13	33%
	Natural Background	433	433	0%
	Total	**452**	**446**	**1%**
Upland Sediment Sources	Forest	71	46	34%
	Range	25	17	34%
	Agriculture	1.1	0.5	57%
	Total	**99**	**64**	**35%**
Total Sediment Load		**560**	**514**	**TMDL = 8% Load Reduction**

* In addition to the quantified allocations, allocations developed at the watershed scale for culverts, road sanding, and storm water permits also apply as defined within **Sections 5.7.2.3** and **5.7.3.4**.
Sediment loads greater than 1 ton were rounded to the nearest whole number, and therefore they do not exactly match the numbers presented in the appendices and within **Section 5.6. The percent reduction values are intended to match the values presented in **Section 5.6** and related appendices.

5.7.3.3 Fortine Creek

Fortine Creek was listed as impaired due to sedimentation/siltation on the 2010 303(d) List. Sediment sources assessed and quantified within the Fortine Creek watershed include roads, streambank erosion, and upland erosion. Human sources of sediment identified during this assessment include roads/transportation, grazing, and hay production.

The current annual sediment load from the assessed sources is estimated at 12,029 tons/year (**Table 5-33**). By applying BMPs, this sediment load to the Fortine Creek watershed could be reduced to 10,920 tons/year. To achieve this reduction, a 56% sediment load reduction is allocated to unpaved roads. This reduction can be accomplished via application of appropriate road BMPs. A 7% reduction is allocated to streambank erosion, which equates to a 33% reduction in the human caused portion of the streambank erosion achieved primarily through improved riparian conditions along streams. Sediment loading sources linked to upland or hillslope erosion are allocated a 30% reduction. Upland erosion reductions are primarily achieved through the application of riparian BMPs or similar buffers to reduce the transport of eroded material to streams, although some reductions can also be achieved via erosion prevention BMPs in upland areas.

The sediment TMDL for Fortine Creek is expressed as a 9% reduction in the total average annual sediment load.

Fortine Creek also has a habitat alteration type of impairment specifically defined as an *alteration in streamside or littoral vegetative covers*. This impairment cause is not a pollutant and does not require TMDL development. The solutions to this habitat problem are included within the water quality protection and improvement activities that must be pursued to meet the Fortine Creek sediment TMDL and associated allocations. Therefore, the Fortine Creek sediment TMDL addresses both the sediment impairment as well as this habitat alteration impairment.

Table 5-33. Quantified Sediment Loads, Allocations and TMDL for Fortine Creek*

Sediment Sources		Current Estimated Load (Tons/Year)**	Potential Estimated Load BMPs (Tons/Year)**	Sediment Load Allocations (% reduction)**
Roads	**Unpaved Roads Total**	**74**	**33**	**56%**
Streambank Erosion	Human Caused	2,243	1,503	33%
	Natural Background	8,606	8,606	0%
	Total	**10,849**	**10,109**	**7%**
Upland Sediment Sources	Forest	803	576	28%
	Range	265	183	31%
	Agriculture	33	16	52%
	Other	5	3	40%
	Total	**1,106**	**778**	**30%**
Total Sediment Load		**12,029**	**10,920**	**TMDL = 9% Load Reduction**

* In addition to the quantified allocations, allocations developed at the watershed scale for culverts, road sanding, and storm water permits also apply as defined within **Sections 5.7.2.3** and **5.7.3.4**.
Sediment loads were rounded to the nearest whole number, and therefore they do not exactly match the numbers presented in the appendices and within **Section 5.6. The percent reduction values are intended to match the values presented in **Section 5.6** and related appendices.

5.7.3.4 Lime Creek

Lime Creek was listed as impaired due to sedimentation/siltation on the 2010 303(d) List. Sediment sources assessed and quantified within the Lime Creek watershed include roads, streambank erosion, and upland erosion. Human sources of sediment identified during this assessment include roads/transportation, grazing, and riparian vegetation removal.

The current annual sediment load from the assessed sources is estimated at 569 tons/year (**Table 5-34**). By applying BMPs, this sediment load to the Lime Creek watershed could be reduced to 514 tons/year. To achieve this reduction, a 56% sediment load reduction is allocated to unpaved roads. This reduction can be accomplished via application of appropriate road BMPs. An 8% reduction is allocated to streambank erosion, which equates to a 33% reduction in the human caused portion of the streambank erosion achieved primarily through improved riparian conditions along streams. Sediment loading sources linked to upland or hillslope erosion are allocated a 29% reduction. Upland erosion reductions are primarily achieved through the application of riparian BMPs or similar buffers to reduce the transport of eroded material to streams, although some reductions can also be achieved via erosion prevention BMPs in upland areas.

The sediment TMDL for Lime Creek is expressed as a 10% reduction in the total average annual sediment load.

Lime Creek also has a habitat alteration type of impairment specifically defined as an *alteration in streamside or littoral vegetative covers*. This impairment cause is not a pollutant and does not require TMDL development. The solutions to this habitat problem are included within the water quality protection and improvement activities that must be pursued to meet the Lime Creek sediment TMDL and associated allocations. Therefore, the Lime Creek sediment TMDL addresses both the sediment impairment as well as this habitat alteration impairment.

Table 5-34. Quantified Sediment Loads, Allocations and TMDL for Lime Creek*

Sediment Sources		Current Estimated Load (Tons/Year)**	Potential Estimated Load BMPs (Tons/Year)**	Sediment Load Allocations (% reduction)**
Roads	**Unpaved Roads Total**	**4**	**2**	**56%**
Streambank Erosion	Human Caused	130	87	33%
	Natural Background	400	400	0%
	Total	**530**	**487**	**8%**
Upland Sediment Sources	Forest	33	23	30%
	Range	2.1	1.5	30%
	Total	**35**	**25**	**29%**
Total Sediment Load		**569**	**514**	**TMDL = 10% Load Reduction**

* In addition to the quantified allocations, allocations developed at the watershed scale for culverts, road sanding, and storm water permits also apply as defined within **Sections 5.7.2.3** and **5.7.3.4.**
Sediment loads were rounded to the nearest whole number, and therefore they do not exactly match the numbers presented in the appendices and within **Section 5.6. The percent reduction values are intended to match the values presented in **Section 5.6** and related appendices.

5.7.3.5 Sinclair Creek

Sinclair Creek was not on 2010 303(d) List, but it was added to the scope of this project based on stakeholder concerns. The source assessment indicates excess sediment associated with human sources is likely impairing beneficial use support and a TMDL is presented here. Sediment sources assessed and quantified within the Sinclair Creek watershed include roads, streambank erosion, and upland erosion. Human sources of sediment identified during this assessment include roads/transportation, grazing, and construction.

The current annual sediment load from the assessed sources is estimated at 1,459 tons/year (**Table 5-35**). By applying BMPs, this sediment load to the Sinclair Creek watershed could be reduced to 1,088 tons/year. To achieve this reduction, a 57% sediment load reduction is allocated to unpaved roads. This reduction can be accomplished via application of appropriate road BMPs. A 25% reduction is allocated to streambank erosion, which equates to a 33% reduction in the human caused portion of the streambank erosion achieved primarily through improved riparian conditions along streams. No reduction is applied to the construction activity based on the assumption that erosion prevention requirements within the construction permit are being met and will continue to be met. Instead, the construction WLA includes an increase in loading in recognition of potential future growth along with continued application of required storm water permit BMPs. Sediment loading sources linked to upland or hillslope erosion are allocated a 37% reduction. Upland erosion reductions are primarily achieved through the application of riparian BMPs or similar buffers to reduce the transport of eroded material to streams, although some reductions can also be achieved via erosion prevention BMPs in upland areas.

The sediment TMDL for Sinclair Creek is expressed as a 25% reduction in the total average annual sediment load.

Table 5-35. Quantified Sediment Loads, Allocations and TMDL for Sinclair Creek*

Sediment Sources		Current Estimated Load (Tons/Year)**	Potential Estimated Sediment Load BMPs (Tons/Year)**	Sediment Load and Wasteload Allocations (% reduction)**
Roads	**Unpaved Roads Total**	**0.7**	**0.3**	**57%**
Streambank Erosion	Human Caused	1,037	695	33%
	Natural Background	344	344	0%
	Total	**1,381**	**1,039**	**25%**
Upland Sediment Sources	Forest	64	41	35%
	Range	7	5	35%
	Agriculture	4	2	58%
	Total	**76**	**48**	**37%**
Point Sources	**Construction Storm Water Permits**	**0.04**	**0.7**	**0%**
Total Sediment Load		**1,459**	**1,088**	**TMDL = 25% Load Reduction**

* In addition to the quantified allocations, allocations developed at the watershed scale for culverts and road sanding also apply as defined within **Section 5.7.2.3**.
Sediment loads greater than 1 ton were rounded to the nearest whole number, and therefore they do not exactly match the numbers presented in the appendices and within **Section 5.6. The percent reduction values are intended to match the values presented in **Section 5.6** and related appendices.

5.7.3.6 Swamp Creek

Swamp Creek was listed as impaired due to sedimentation/siltation on the 2010 303(d) List. Sediment sources assessed and quantified within the Swamp Creek watershed include roads, streambank erosion, and upland erosion. Human sources of sediment identified during this assessment include roads/transportation, silviculture, channel modifications, and removal of riparian vegetation.

The current annual sediment load from the assessed sources is estimated at 1,669 tons/year (**Table 5-36**). By applying BMPs, this sediment load to the Swamp Creek watershed could be reduced to 1,477 tons/year. To achieve this reduction, a 57% sediment load reduction is allocated to unpaved roads. This reduction can be accomplished via application of appropriate road BMPs. A 7% reduction is allocated to streambank erosion, which equates to a 33% reduction in the human caused portion of the streambank erosion achieved primarily through improved riparian conditions along streams. Sediment loading sources linked to upland or hillslope erosion are allocated a 37% reduction. Upland erosion reductions are primarily achieved through the application of riparian BMPs or similar buffers to reduce the transport of eroded material to streams, although some reductions can also be achieved via erosion prevention BMPs in upland areas.

The sediment TMDL for Swamp Creek is expressed as a 12% reduction in the total average annual sediment load.

Swamp Creek also has a habitat alteration type of impairment specifically defined as an *alteration in streamside or littoral vegetative covers*. This impairment cause is not a pollutant and does not require TMDL development. The solutions to this habitat problem are included within the water quality protection and improvement activities that must be pursued to meet the Swamp Creek sediment TMDL and associated allocations. Therefore, the Swamp Creek sediment TMDL addresses both the sediment impairment as well as this habitat alteration impairment.

Table 5-36. Quantified Sediment Loads, Allocations and TMDL for Swamp Creek*

Sediment Sources		Current Estimated Load (Tons/Year)**	Potential Estimated Load BMPs (Tons/Year)**	Sediment Load Allocations (% reduction)**
Roads	**Unpaved Roads Total**	**9**	**4**	**57%**
Streambank Erosion	Human Caused	285	191	33%
	Natural Background	1,123	1,123	0%
	Total	**1,408**	**1,314**	**7%**
Upland Sediment Sources	Forest	149	94.5	37%
	Range	103	65	37%
	Total	**252**	**159**	**37%**
Total Sediment Load		**1,669**	**1,477**	**TMDL = 12% Load Reduction**

* In addition to the quantified allocations, allocations developed at the watershed scale for culverts, road sanding, and storm water permits also apply as defined within **Sections 5.7.2.3** and **5.7.3.4**.
Sediment loads were rounded to the nearest whole number, and therefore they do not exactly match the numbers presented in the appendices and within **Section 5.6. The percent reduction values are intended to match the values presented in **Section 5.6** and related appendices.

5.7.3.7 Therriault Creek

Therriault Creek was listed as impaired due to sedimentation on the 2010 303(d) List. Sediment sources assessed and quantified within the Therriault Creek watershed include roads, streambank erosion, and upland erosion. Human sources of sediment identified during this assessment include roads/transportation, historic silviculture and grazing, and channel modification.

The current annual sediment load from the assessed sources is estimated at 537 tons/year (**Table 5-37**). By applying BMPs, this sediment load to the Therriault Creek watershed could be reduced to 454 tons/year. To achieve this reduction, a 52% sediment load reduction is allocated to unpaved roads. This reduction can be accomplished via application of appropriate road BMPs. An 11% reduction is allocated to streambank erosion, which equates to a 33% reduction in the human caused portion of the streambank erosion achieved primarily through improved riparian conditions along streams. Sediment loading sources linked to upland or hillslope erosion are allocated a 34% reduction. Upland erosion reductions are primarily achieved through the application of riparian BMPs or similar buffers to reduce the transport of eroded material to streams, although some reductions can also be achieved via erosion prevention BMPs in upland areas.

The sediment TMDL for Therriault Creek is expressed as a 16% reduction in the total average annual sediment load.

Table 5-37. Quantified Sediment Loads, Allocations and TMDL for Therriault Creek*

Sediment Sources		Current Estimated Load (Tons/Year)**	Potential Estimated Load BMPs (Tons/Year)**	Sediment Load Allocations (% reduction)**
Roads	**Unpaved Roads Total**	**3**	**1**	**52%**
Streambank Erosion	Human Caused	141	95	33%
	Natural Background	290	290	0%
	Total	**433**	**385**	**11%**
Upland Sediment Sources	Forest	88	59	33%
	Range	5	4	33%
	Agriculture	8	3	57%
	Total	**101**	**67**	**34%**
Total Sediment Load		**537**	**453**	**TMDL = 16% Load Reduction**

* In addition to the quantified allocations, allocations developed at the watershed scale for culverts, road sanding, and storm water permits also apply as defined within **Sections 5.7.2.3** and **5.7.3.4**.
Sediment loads were rounded to the nearest whole number, and therefore they do not exactly match the numbers presented in the appendices and within **Section 5.6. The percent reduction values are intended to match the values presented in **Section 5.6** and related appendices.

5.7.3.8 Tobacco River

The Tobacco River was listed as impaired due to sedimentation on the 2010 303(d) List. Sediment sources assessed and quantified within the Tobacco River watershed include roads, streambank erosion, upland erosion and permitted point sources. The assessment results represent the cumulative total loading and associated reductions for the complete watershed, including Grave Creek loading contributions to the Tobacco River. Human sources of sediment identified during this assessment include roads/transportation, channel modifications, historic log drives, riparian vegetation removal, and permitted point sources.

The current annual sediment load from the assessed sources is estimated at 23,097 tons/year (**Table 5-38**). By applying BMPs, this sediment load to the Tobacco River watershed could be reduced to 20,631 tons/year. To achieve this reduction, a 57% sediment load reduction is allocated to unpaved roads. This reduction can be accomplished via application of appropriate road BMPs. An 8% reduction is allocated to streambank erosion, which equates to a 33% reduction in the human caused portion of the streambank erosion achieved primarily through improved riparian conditions along streams. Sediment loading sources linked to upland or hillslope erosion are allocated a 31% reduction. Upland erosion reductions are primarily achieved through the application of riparian BMPs or similar buffers to reduce the transport of eroded material to streams, although some reductions can also be achieved via erosion prevention BMPs in upland areas.

WLAs are provided for Eureka Sewage Treatment facility, Timberline Ready Mix, and construction storm water permits. The industrial stormwater facility (Timberline) has no reduction applied based on the assumption that erosion prevention requirements within its storm water permit are being met and will continue to be met. A composite construction stormwater wasteload allocation applies to multiple sites but none of them are allocated a reduction in loading also based on the assumption that erosion prevention requirements within the construction permits are being met and will continue to be met. Instead, the construction WLA includes an increase in loading in recognition of potential future growth along with continued application of required storm water permit BMPs. The WLA for the Waste Water Treatment Plant is based on existing permit limits.

The sediment TMDL for the Tobacco River is expressed as an 11% reduction in the total average annual sediment load.

The Tobacco River Creek also has a *physical substrate habitat alterations* impairment. This impairment cause is not a pollutant and does not require TMDL development. The solutions to this habitat problem are included within the water quality protection and improvement activities that must be pursued to meet the Tobacco River sediment TMDL and associated allocations. Therefore, the Tobacco River sediment TMDL addresses both the sediment impairment as well as this habitat alteration impairment.

Table 5-38. Quantified Sediment Loads, Allocations and TMDL for Tobacco River*

Sediment Sources		Current Estimated Load (Tons/Year)**	Potential Estimated Load BMPs (Tons/Year)**	Sediment Load and Wasteload Allocations (% reduction)**
Roads	**Unpaved Roads Total**	**98**	**42**	**57%**
Roads	**Road Sand**	**11**	**11**	**0%**
Streambank Erosion	Human Caused	5,282	3,544	33%
	Natural Background	15,402	15,402	0%
	Total	**20,684**	**18,946**	**8%**
Upland Sediment Sources	Forest	1,717	1,215	29%
	Range	439	303	31%
	Agriculture	124	55	56%
	Other	17	12	29%
	Total	**2,297**	**1,585**	**31%**
Point Sources	**Eureka Sewage Treatment**	**10**	**34**	**0%**
	Timberline Ready Mix	**0**	**0.03**	**0%**
	Construction Storm Water Permits	**0.8**	**5**	**0%**
Total Sediment Load		**23,101**	**20,623**	**TMDL = 11% Load Reduction**

* In addition to the quantified allocations, an allocation developed at the watershed scale for culvert also applies as defined within **Sections 5.7.2.3**.
Sediment loads were rounded to the nearest whole number, and therefore they do not exactly match the numbers presented in the appendices and within **Section 5.6. The percent reduction values are intended to match the values presented in **Section 5.6** and related appendices.

Grave Creek Loads and TMDL Linkages

Grave Creek flows into Fortine Creek to form the Tobacco River. Therefore, Grave Creek sediment loading information is applicable to the Tobacco River sediment source assessment and subsequent development of the Tobacco River sediment TMDL and allocations. The sediment source assessment methods defined within Appendices E, F, and G generally differ from the methods that were used for development of the 2005 Grave Creek sediment TMDL (Montana Department of Environmental Quality, 2005). On the other hand, the 2011 Tobacco River TMDL and 2005 Grave Creek TMDL load allocations are developed using similar percent reduction approaches; both being based on the application of sediment load reduction practices and associated BMPs. The resulting allocations from the Grave Creek watershed to the Tobacco River, as defined by this document, do not supersede sediment allocations applicable to Grave Creek as defined by the Grave Creek TMDL. Each allocation scenario within each document must be addressed to ensure compliance with the applicable water quality standards for the Tobacco River as well as Grave Creek. Below are comparisons of the source assessment methods and allocation approaches for the 2011 Tobacco River sediment TMDL and for the 2005 Grave Creek sediment TMDL.

- Streambank Erosion
  Streambank erosion loading for the Grave Creek watershed was evaluated for both TMDL documents using a similar BEHI method. The 2005 Grave Creek TMDL sediment load results are based on significantly more data collected along Grave Creek, whereas the 2011 Tobacco River TMDL sediment load results are based almost completely on extrapolation from other assessed streams throughout the Tobacco TPA. The allocation approach for each TMDL is based on an assessment of achievable reductions in human controlled impacts, and meeting the allocation in each document is based on applying appropriate erosion prevention BMPs mostly linked to improved riparian health along streambanks. A more detailed comparison of the bank erosion assessments and associated allocations is provided within **Section 5 of Appendix E**.

- Upland Erosion
  Grave Creek upland erosion loading and percent reduction scenarios for the 2011 Tobacco River TMDL are defined within **Appendix F**. Although the 2005 Grave Creek TMDL does not include an equivalent upland erosion loading analysis, the 2005 Grave Creek TMDL does include a load allocation that applies to forestry management activity consistent with the forest landscape allocation within the 2011 Tobacco River TMDL. The allocation within each document allows for limited upland erosion sediment loading from forest management activity based on the assumption of continued application of all appropriate forest practices BMPs.

- Roads
  Road source assessment loading and percent reduction scenarios for the 2011 Tobacco River TMDL are provided within **Appendix G**. The road loading results from the Tobacco TPA watersheds were used to extrapolate a load for unpaved crossings within the Grave Creek watershed as described within **Section 3.3** of **Appendix G**. This was necessary because the 2005 Grave Creek TMDL roads assessment was based on a completely different modeling method that is not comparable to the method used for the 2011 Tobacco River TMDL roads assessment.

  The 2005 Grave Creek TMDL road allocation includes a reduction in culvert failure risk consistent with the 2011 Tobacco TMDL culvert failure allocation. The 2005 Grave Creek TMDL road crossing allocation is no increase in road erosion loading (0% reduction) based on application of appropriate road BMPs. The 2011 Tobacco TMDL applies a seemingly more stringent 57% load reduction to unpaved crossings within the Grave Creek watershed. For the 2011 Tobacco River TMDL, existing BMP applications in the Grave Creek watershed were assumed consistent with the remainder of the Tobacco TPA where it was estimated that the application of BMPs could result in a 57% load reduction. For the Grave Creek TMDL, it was assumed that road crossing BMPs were mostly in place; although it is pointed out that road BMPs should be maintained or improved where BMPs are lacking. In reality, meeting the road load allocation for each TMDL is based on application of appropriate road crossing BMPs at all locations.

- Permitted Point Sources
  Permitted point sources were not identified with the Grave Creek watershed and thus were not incorporated into the Grave Creek TMDL.

- Mass Wasting
  Sediment loading from mass wasting was not evaluated as a unique loading source for the Tobacco TPA TMDL source assessment. Mass wasting was evaluated for the Grave Creek TMDL and was identified as a significant source of sediment loading. The allocation for Grave Creek allowed for no future sediment loading from mass wasting linked to a lack of BMPs for human related activities. This document addresses mass wasting prevention as follows:
  - The bank erosion sediment assessment should capture mass wasting loading adjacent to or along streambanks, and the bank erosion allocation approach incorporates BMPs to avoid mass wasting near streams via riparian protection improvement assumptions.
  - The upland sediment erosion model and assumptions linked to continued application of forestry BMPs is consistent with mass wasting prevention.
  - The roads allocations include BMPs at crossings and culvert upgrades that should reduce mass wasting potential.

5.7.4 Meeting the Intent of TMDL Allocations

It is important to recognize that the first critical step toward meeting the sediment allocations involves applying and/or maintaining the land management practices or BMPs that will reduce sediment loading. Once these actions have been completed at a given location, the landowner or land manager will have taken action consistent with the intent of the sediment allocation for that location. For many nonpoint source activities, it can take several years to achieve the full load reduction at the location of concern, even though full BMP implementation is in effect. For example, it may take several years for riparian areas to fully recover after implementing grazing BMPs or allowing re-growth in areas of historic riparian harvest.

It is also important to apply proper BMPs and other water quality protection practices for all new or changing land management activities to limit any potential increased sediment loading. For example, a landowner or land manager that negatively impacts an existing healthy riparian area might increase sediment loading in a manner that is not consistent with the bank erosion and/or upland sediment load allocations that apply throughout the watershed.

Additional information regarding the implementation of the allocations and associated BMPs is contained in **Sections 6** and **7**.

5.8 Seasonality and Margin of Safety

Seasonality and margin of safety are both required elements of TMDL development. This section describes how seasonality and margin of safety were applied during development of the Tobacco River TPA sediment TMDLs.

5.8.1 Seasonality

All TMDL documents must consider the seasonal applicability of water quality standards as well as the seasonal variability of pollutant loads to a stream. Seasonality was addressed in several ways as described below.

- The applicable narrative water quality standards (**Appendix C**) are not seasonally dependent, although low flow conditions provide the best ability to measure harm to use based on the selected target parameters. The low flow or base flow condition represents the most practical time period for assessing substrate and habitat conditions, and also represents a time period when high fine sediment in riffles or pool tails will likely influence fish and aquatic life. Therefore, meeting targets during this time frame represents an adequate approach for determining standards attainment.
- The substrate and habitat target parameters within each stream are measured during summer or autumn low flow conditions consistent with the time of year when reference stream measurements are conducted. This time period also represents an opportunity to assess effects of the annual snow runoff and early spring rains, which is the typical time frame for sediment loading to occur.
- The DEQ sampling protocol for macroinvetebrates identifies a specific time period for collecting samples based on macroinvertebrate life cycles. This time period coincides with the low flow or base flow condition.
- All assessment modeling approaches are standard approaches that specifically incorporate the yearly hydrologic cycle specific to the Tobacco watershed. The resulting loads are expressed as average yearly loading rates to fully assess loading throughout the year.
- Allocations are based on average yearly loading and the preferred TMDL expression is as an average yearly load reduction, consistent with the assessment methods.

5.8.2 Margin of Safety

Natural systems are inherently complex. Any approach used to quantify or define the relationship between pollutant loading rates and the resultant water quality impacts, no matter how rigorous, will include some level of uncertainty or error. To compensate for this uncertainty and ensure water quality standards are attained, a margin of safety is required as a component of each TMDL. The MOS may be applied implicitly by using conservative assumptions in the TMDL development process or explicitly by setting aside a portion of the allowable loading (U.S. Environmental Protection Agency, 1999). This plan incorporates an implicit MOS in a variety of ways:

- By using multiple targets to assess a broad range of physical and biological parameters known to illustrate the effects of sediment in streams and rivers. These targets serve as indicators of potential impairment from sediment and also help signal recovery, and eventual standards attainment, after TMDL implementation. Conservative assumptions were used during development of these targets.
- TMDL development was pursued for all streams evaluated, even though some streams were close to meeting all target values. This approach addresses some of the uncertainty associated with sampling variability and site representativeness, and recognizes that sediment source reduction capabilities exist throughout the watershed.
- By using standards, targets, and TMDLs that address both coarse and fine sediment delivery.
- By properly incorporating seasonality into target development, source assessments, and TMDL allocations.

- By using an adaptive management approach to evaluate target attainment and allow for refinement of load allocation, targets, modeling assumptions, and restoration strategies to further reduce uncertainties associated with TMDL development (discussed below in **Section 5.9** and in **Sections 6** and **7**).
- By using naturally occurring sediment loads as described in ARM 17.30.602(17) (see **Appendix C**) to establish the TMDLs and allocations based on reasonably achievable load reductions for each source category. Specifically, each major source category must meet percent reductions to satisfy the TMDL because of the relative loading uncertainties between assessment methodologies.
- TMDLs are developed at the watershed scale addressing all potentially significant human related sources beyond just the impaired waterbody segment scale. This approach should also reduce loading and improve water quality conditions within other tributary waterbodies throughout the watershed.

5.9 TMDL Development Uncertainties and Adaptive Management

A degree of uncertainty is inherent in any study of watershed processes. While uncertainties are an undeniable fact of TMDL development, mitigation and reduction of uncertainty through adaptive management is a key component of TMDL implementation. The process of adaptive management is predicated on the premise that TMDLs, allocations and their supporting analyses are not static, but are processes that can be subject to periodic modification or adjustment as new information and relationships are better understood. Within the Tobacco TPA, adaptive management for sediment TMDLs relies on continued monitoring of water quality and stream habitat conditions, continued assessment of impacts from human activities and natural conditions, and continued assessment of how aquatic life and coldwater fish respond to changes in water quality and stream habitat conditions.

As noted in **Section 5.8.2**, adaptive management represents an important component of the implicit margin of safety. This document provides a framework to satisfy the MOS by including a section focused on TMDL implementation, monitoring and adaptive management (**Section 6**). Furthermore, state law (ARM 75-5-703), requires monitoring to gage progress toward meeting water quality standards and satisfying TMDL requirements. These TMDL implementation monitoring reviews represent an important component of adaptive management in Montana.

Perhaps the most significant uncertainties within this document involve the accuracy and representativeness of 1) field data and target development and 2) the accuracy and representativeness of the source assessments and associated load reductions. These uncertainties and approaches used to reduce uncertainty are discussed in following subsections.

5.9.1 Sediment and Habitat Data Collection and Target Development

Some of the uncertainties regarding accuracy and representativeness of the data and information used to characterize existing water quality conditions and develop water quality targets are discussed below.

<u>Data Collection</u>

The stream sampling approach used to characterize water quality is described within **Appendix D**. To control sampling variability and improve accuracy, the sampling was done by trained environmental professionals using a standard DEQ procedure developed for the purpose of sediment TMDL development (Montana Department of Environmental Quality, 2010). This procedure defines specific methods for each parameter, including sampling location and frequency to ensure proper representation and applicability of results. Prior to any sampling, a sampling and analysis plan (SAP) was developed to ensure that all activity was consistent with applicable quality control and quality assurance requirements. Site selection was a major component of the SAP, and was based on a stratification process described in **Appendix D**. The stratification work ensured that each stream included one or more sample sites representing a location where excess sediment loading or altered stream habitat could affect fish or aquatic life.

Even with the applied quality controls, a level of uncertainty regarding overall accuracy of collected data will exist. There is uncertainty regarding whether or not the appropriate sites were assessed and whether or not an adequate number of sites were evaluated for each stream. Also, there is the uncertainty of the representativeness of collecting data from one sampling season. These uncertainties are difficult to quantify and even more difficult to eliminate given resource limitations and occasional stream access problems.

Target Development

DEQ evaluated several data sets to ensure that the most representative information and most representative statistic was used to develop each target parameter consistent with the reference approach framework outlined in **Appendix C**. Using reference data is the preferred approach for target setting, however, some uncertainty is introduced because of differing protocols between the available reference data and DEQ data for the Tobacco TPA. These differences were acknowledged within the target development discussion and taken into consideration during target setting. For each target parameter, DEQ stratified the Tobacco sample results and target data into similar categories, such as stream width or Rosgen stream type, to ensure that the target exceedance evaluations were based on appropriate comparison characteristics.

The established targets are meant to apply under median conditions of natural background and natural disturbance. It is recognized that under some natural conditions such as a large fire or flood event, it may be impossible to satisfy one or more of the targets until the stream and/or watershed recovers from the natural event. The goal, under these conditions, is to ensure that management activities are undertaken in a way that the achievement of targets is not significantly delayed in comparison to the natural recovery time. Also, human activity should not significantly increase the extent of water quality impacts from natural events. For example, extreme flood events can cause a naturally high level of sediment loading that could be significantly increased from a large number of road crossing or culvert failures.

Because sediment target values are based on statistical data percentiles, DEQ recognizes that it may be impossible to meet all targets for some streams even under normal levels of disturbance. This does not appear to be a major concern throughout the Tobacco TPA since most streams are close to satisfying the majority of the target values. On the other hand, some target values may underestimate the potential of a given stream and it may be appropriate to apply more protective targets upon further evaluation during adaptive management. This also does not appear to be a major concern because the current levels of human disturbances are not extremely high based on overall percent loading reductions. Furthermore, it appears that much of the watershed has recovered from historical practices that negatively affected water quality and stream habitat. It is important to recognize that the adaptive management approach provides the flexibility to refine targets as necessary to ensure protection of the resource and to adapt to new information concerning target achievability.

5.9.9.2 Source Assessments and Load Reduction Analyses

Each assessment method introduces uncertainties regarding the accuracy and representativeness of the sediment load estimates and percent load reduction analyses. For each source assessment, assumptions must be made to evaluate sediment loading and potential reductions at the watershed scale, and because of these uncertainties, conclusions may not be representative of existing conditions and achievable reductions at all locations within the watershed. Uncertainties are discussed independently for the three major source categories of bank erosion, upland erosion, and unpaved road crossings.

<u>Bank Erosion</u>

The load quantification approach for bank erosion is based on a standard methodology (BEHI) as defined within **Appendix D**. Field data collection was by trained environmental professionals per a standard DEQ procedure (Montana Department of Environmental Quality, 2010). Prior to any sampling, a SAP was developed to ensure that all activity was consistent with applicable quality control and quality assurance requirements. Site selection was a major component of the SAP, and was based on a stratification process described in **Appendix D**. Additional bank erosion assessment sites were added to better represent the various stratified stream reaches. The results were then extrapolated across the Tobacco watersheds as defined in **Appendix E** to provide an estimate of the relative bank erosion loading from various streams and associated stream reaches.

Even with the above quality controls, there is uncertainty regarding the bank retreat rates, which directly influence loading rates, since it was necessary to apply bank retreat values established from Wyoming's Lamar River. Even with the increased bank erosion sites, stratifying and assessing each unique reach type was not practical, therefore adding to uncertainty associated with the load extrapolation results. Also, the complexity of the BEHI methodology can introduce error and uncertainty, although this is somewhat limited by the averaging component of the measured variables.

There is additional uncertainty regarding the amount of bank erosion linked to human activities and the specific human sources, as well as the ability to reduce the human related bank erosion levels. This is further complicated by historic human disturbances in the watershed, which could still be influencing proper channel shape, pattern and profile and thus contributing to increased bank erosion loading that may appear natural. Even if difficult to quantify, the linkages between human activity such as riparian clearing and bank erosion, are well established and these linkages clearly exist at different locations throughout the Tobacco watershed. Evaluating bank erosion levels, particularly where best management practices have been applied along streams, is an important part of adaptive management that can help define the level of human-caused bank erosion as well as the relative impact that bank erosion has on water quality throughout the Tobacco watershed.

<u>Upland Erosion</u>

A professional modeler determined upland erosion loads applying a standard erosion model as defined in **Appendix F**. As with any model, there will be uncertainty in the model input parameters including uncertainties regarding land use, land cover and assumptions regarding existing levels of BMP application. For example, the model only allows one vegetative condition per land cover type (i.e., cannot reflect land management practices that change vegetative cover from one season to another), so an average condition is used for each scenario in the model. To minimize uncertainty regarding existing conditions and management practices, model inputs were reviewed by stakeholders familiar with the watershed.

The upland erosion model integrates sediment delivery based on riparian health, with riparian health evaluations linked to the stream stratification work discussed above. The potential to reduce sediment loading was based on modest land cover improvements to reduce the generation of eroded sediment particles in combination with riparian improvements. The uncertainty regarding existing erosion prevention BMPs and ability to reduce erosion with additional BMPs represents a level of uncertainty. Also, the reductions in sediment delivery from improved riparian health also introduces some uncertainty, particularly in forested areas where there is uncertainty regarding the influence that historical riparian logging has on upland sediment delivery. Even with these uncertainties, the ability to reduce upland sediment erosion and delivery to nearby waterbodies is well documented in literature and the reduction values used for estimating load reductions and setting allocations are based on literature values coupled with specific assessment results for the Tobacco watershed.

Roads

The most significant road sediment load was linked to unpaved road crossings. As described in **Appendix G**, the road crossings sediment load was estimated via a standardized simple yearly model developed by the U.S. Forest Service. This model relies on a few basic input parameters that are easily measured in the field, as well as inclusion of precipitation data from local weather stations. A total of 50 sites were randomly selected for evaluation, representing about 4% of the total population of roads. The results from these 50 sites were extrapolated to the whole population of roads stratified by landscape type. The reduction potential for all roads was also based on data collected from the 50 sites taking into consideration existing BMP conditions. This approach introduces uncertainty based on how well the 50 sites and associated BMPs represent the whole population. The average reduction of 57% used for road allocations appears to be a reasonable representation of the overall achievable sediment load reduction since this result is consistent with findings from similar TMDL evaluations in other watersheds within western Montana (Montana Department of Environmental Quality, 2008; Montana Department of Environmental Quality, 2011; Montana Department of Environmental Quality, 2009). Although the exact percent reduction will vary by road, the analysis clearly shows a high potential for sediment loading reduction by applying standard road BMPs in places where they are lacking or can be improved.

Application of Source Assessment Results

Model results should not be applied as absolute accurate sediment loading values within each watershed or for each source category because of the uncertainties discussed above. Because of the uncalibrated nature of the source assessment work, the relative percentage of the total load from each source category does not necessarily indicate its importance as a loading source. Instead, the intention is to separately evaluate source impacts within each assessment category (e.g., bank erosion, upland erosion, roads) and use the modeling and assessment results from each source category to evaluate reduction potentials based on different BMP scenarios. The process of adaptive management can help sort out the relative importance of the different source categories through time.

6.0 TMDL Implementation Framework: Water Quality Restoration and Monitoring Recommendations

6.1 TMDL Implementation and Monitoring Framework

While certain land uses and human activities are identified as sources and causes of water quality impairment during TMDL development, the management of these activities is of more concern than the activities themselves. This document does not advocate for the removal of land and water uses to achieve water quality restoration objectives, but instead for making changes to current and future land management practices that will help improve and maintain water quality. This section discusses the framework for TMDL implementation and a monitoring strategy to help ensure successful TMDL implementation and attainment of water quality standards.

6.1.1 Agency and Stakeholder Coordination

DEQ does not implement TMDL pollutant reduction projects for nonpoint source activities, but can provide technical and financial assistance for stakeholders interested in improving their water quality. DEQ will work with participants to use these TMDLs as a basis for developing locally-driven watershed restoration plans, administer funding specifically for water quality improvement and pollution prevention projects, and can help identify other sources of funding.

Because most nonpoint source reductions rely on voluntary measures, it is important that local landowners, watershed organizations, and resource managers continue to work collaboratively with local and state agencies to achieve water quality restoration goals which will progress toward meeting TMDL targets and load reductions. Specific stakeholders and agencies that have been and will likely continue to be vital to restoration and water quality maintenance efforts include the Kootenai River Network (KRN), the United States Forest Service - Kootenai National Forest (KNF), Montana Fish Wildlife & Parks (FWP), Montana Department of Environmental Quality (DEQ), the United States Fish and Wildlife Service (USFWS). Additionally, local land managers, stakeholder groups, and other state and federal agencies may be helpful in providing technical, financial or coordination assistance.

6.1.2 Water Quality Restoration Plan Development

A watershed restoration plan (WRP) can provide a framework strategy for water quality restoration and monitoring in the Tobacco TPA, focusing on how to meet conditions that will likely achieve the TMDLs presented in this document, as well as other water quality issues of interest to local communities and stakeholders. Watershed restoration plans identify considerations that should be addressed during TMDL implementation and should assist stakeholders in developing a more detailed adaptive plan in the future. A locally developed WRP will likely provide more detailed information about restoration goals and spatial considerations but may also encompass more broad goals than this framework includes. A WRP would serve as a locally organized “road map” for watershed activities, sequences of projects, prioritizing of projects, and funding sources for achieving local watershed goals, including water quality improvements. The WRP is intended to be a living document that can be revised based on new information related to restoration effectiveness, monitoring results, and stakeholder priorities. The following are key elements suggested for the WRP:

- Implement best management practices (BMPs) to protect water conditions so that all streams in the watershed maintain good quality, with an emphasis on waters with completed TMDLs.

- Develop more detailed cost-benefit and spatial considerations for water quality improvement projects.
- Develop an approach for future BMP installments and efficiency results tracking.
- Provide information and education to reach out to stakeholders about approaches to restoration, its benefits, and funding assistance.

DEQ encourages collaboration among local stakeholders, interested parties, state and federal agencies toward development of a WRP for the Tobacco TPA, or preferably for the whole Tobacco watershed by combining WRP planning for the Tobacco TPA and Grave Creek watersheds since significant TMDL implementation and water quality protection activities are underway and well established for the Grave Creek watershed.

6.1.3 Adaptive Management and Uncertainty

An adaptive management approach is recommended to manage resource commitments as well as achieve success in meeting the water quality standards and supporting all beneficial uses. This approach works in cooperation with the monitoring strategy and allows for adjustments to the restoration goals or pollutant targets, TMDLs, and/or allocations, as necessary. These adjustments would take into account new information as it arises.

The adaptive management approach is outlined below:

- TMDLs and Allocations: The analysis presented in this document assumes that the load reductions proposed for each of the listed streams will enable the streams to meet target conditions and further assumes that meeting target conditions will ensure full support of all beneficial uses. Much of the monitoring proposed in this section of the document is intended to validate this assumption. If it looks like greater reductions in loading or improved performance is necessary to meet targets, then updated TMDL and/or allocations will be developed based on achievable reductions via application of reasonable land, soil, and water conservations practices.
- Water Quality Status: As new stressors are added to the watershed and additional data are collected, new water quality targets may need to be developed or existing targets/allocations may need to be modified. Additionally, as restoration activities are conducted in the Tobacco TPA and target variables move towards target conditions, the impairment status of the 303(d) listed waterbodies is expected to change. An assessment of the impairment status will occur after significant restoration occurs in the watershed.

6.1.4 Funding and Prioritization

Funding and prioritization of restoration or water quality improvement project is integral to maintaining restoration activity and monitoring successes and failures. Several government agencies fund watershed or water quality improvement projects. Below is a brief summary of potential funding sources to assist with TMDL implementation.

Section 319 funding

Section 319 grant funds are typically used to help identify, prioritize, and implement water quality protection projects with focus on TMDL development and implementation of nonpoint source projects. Individual contracts under the yearly grant typically range from $20,000 to $150,000, with a 40 percent match requirement. 319 projects typically need to be administered through a non-profit or local government such as a conservation district, a watershed planning group, or a county. The KRN has received 319 funding to assist with restoration projects in the Grave Creek and Therriault Creek watersheds and to facilitate Grave Creek TMDL development as well as development of the TMDLs within this document.

Future Fisheries Improvement Program

The Future Fisheries grant program is administered by FWP and offers funding for on-the-ground projects that focus on habitat restoration to benefit wild and native fish. Anyone ranging from a landowner or community-based group to a state or local agency is eligible to apply. Applications are reviewed annually in December and June. Projects that may be applicable to the Tobacco TPA include restoring streambanks, improving fish passage, and restoring/protecting spawning habitats.

Watershed Planning and Assistance Grants

The MT DNRC administers Watershed Planning and Assistance Grants to watershed groups that are sponsored by a Conservation District. Funding is capped at $10,000 per project and the application cycle is quarterly. The grant focuses on locally developed watershed planning activities; eligible activities include developing a watershed plan, group coordination costs, data collection, and educational activities.

Other Funding Sources

Numerous other funding opportunities exist for addressing nonpoint source pollution. Additional information regarding funding opportunities from state agencies is contained in Montana's Nonpoint Source Management Plan (DEQ, 2007) and information regarding additional funding opportunities can be found at http://www.epa.gov/nps/funding.html.

6.2 Implementation Strategies and Recommendations

For each major source of human-caused pollutant loads in the Tobacco TPA, general management recommendations are outlined below. The effect of different sources can change seasonally and be dependent on the magnitude of storm/high flow events. Therefore, restoration activities within the Tobacco TPA should focus on all major sources for each pollutant category. Yet, restoration should begin with addressing significant sources where large load reductions can be obtained within each source category. For each major source, BMPs will be most effective as part of a management strategy that focuses on critical areas within the watershed, which are those areas contributing the largest pollutant loads or are especially susceptible to disturbance. The source assessment results provided within **Appendices E, F** and **G** and summarized in **Section 5.6** provide information that should be used to help determine priorities for each major source type in the watershed and for each of the general management recommendations discussed below in **Sections 6.2.1** through **6.2.12**.

Applying BMPs for existing activities where they are currently needed is the core of TMDL implementation but only forms a part of the restoration strategy. Also important are efforts to avoid future load increases by ensuring that new activities within the watershed incorporate all appropriate BMPs, and ensuring continued implementation and maintenance of those BMPs currently in place or in practice. Restoration might also address other current pollution-causing uses and management practices. In some cases, efforts beyond implementing new BMPs may be required to address key sediment sources. In these cases, BMPs are usually identified as a first effort followed by an adaptive management approach to determine if further restoration activities are necessary to achieve water quality standards. Monitoring is also an important part of the restoration process; recommendations are outlined in **Section 6.3**.

6.2.1 Riparian and Floodplain Management

Riparian areas and floodplains are critical for wildlife habitat, groundwater recharge, reducing the severity of floods and upland and streambank erosion, and filtering pollutants from runoff. Therefore, enhancing and protecting riparian areas and floodplains within the watershed should be a priority of TMDL implementation in the Tobacco TPA.

Initiatives to protect riparian areas and floodplains will help protect property, increase channel stability, and buffer waterbodies from pollutants. However, in areas with a much smaller buffer or where historical vegetation removal and development have shifted the riparian vegetation community and limited its functionality, a tiered approach for restoring stream channels and adjacent riparian vegetation should be considered that prioritizes areas for restoration based on the existing condition and potential for improvement. In non-conifer dominated areas, the restoration goals should focus on restoring natural shrub cover on streambanks to riparian vegetation target levels associated with the sediment TMDLs. Passive riparian restoration is preferable, but in areas where stream channels are unnaturally stable or streambanks are eroding excessively, active restoration approaches, such as channel design, woody debris and log vanes, bank sloping, seeding, and shrub planting may be needed. Factors influencing appropriate riparian restoration would include the severity of degradation, site-potential for various species, and the availability of local sources as transplant materials. In general, riparian plantings would promote the establishment of functioning stands of native riparian species. Weed management should also be a dynamic component of managing riparian areas.

The use of riprap or other “hard” approaches is not recommended and is not consistent with water quality protection or implementation of this plan. Although they may be absolutely necessary in some instances, these “hard” approaches generally redirect channel energy and exacerbate erosion in other places. Bank armoring should be limited to areas with a demonstrated infrastructure threat. Where deemed necessary, apply bioengineered bank treatments to induce vegetative reinforcement of the upper bank, reduce stream scouring energy, and provide shading and cover habitat.

6.2.2 Grazing Management

Development of riparian grazing management plans should be a goal for landowners in the watershed who are not currently using a plan. Private land owners may be assisted by state, county federal, and local conservation groups to establish and implement appropriate grazing management plans. Note that riparian grazing management does not necessarily eliminate all grazing in these areas. Nevertheless, in some areas, a more restrictive management strategy may be necessary for a period in order to accelerate re-establishment of a riparian community with the most desirable species composition and structure. Grazing should be managed to provide filtering capacity via adequate groundcover, streambank stability via mature riparian vegetation communities, and shading from mature riparian climax communities.

Grazing management includes the timing and duration of grazing, the development of multipasture systems, including riparian pastures, and the development of off-site watering areas. The key strategy of the recommended grazing BMPs is to develop and maintain healthy riparian vegetation and minimize disturbance of the streambank and channel. The primary recommended BMPs for the Tobacco TPA are providing off-site watering sources, limiting livestock access to streams, providing “water gaps” where livestock access to a stream is necessary, planting woody vegetation along streambanks, and establishing riparian buffers. Although passive restoration via new grazing plans or limited bank revegetation are a preferred BMPs, in some instances bank stabilization may be necessary prior to planting vegetation. Other general grazing management recommendations and BMPs to address grazing sources of pollutants and pollution can be obtained in **Appendix A** of Montana's NPS Management Plan (DEQ, 2007).

6.2.3 Small Acreages

Small acreages are growing rapidly, and many small acreage owners own horses or cattle. Animals grazing on small acreages can lead to overgrazing and a shortage of grass cover, leaving the soil subject to erosion and runoff to surface waters. General BMP recommendations for small acreage lots with animals include creating drylots, developing a rotational grazing system, and maintaining healthy riparian buffers. Small acreage owners should collaborate with MSU Extension Service, NRCS, conservation districts and agriculture organizations to develop management plans for their lots. Further information may be obtained from the Montana Nonpoint Source Management Plan (DEQ, 2007) or the MSU extension website at: http://www.msuextension.org/ruralliving/Index.html.

6.2.4 Animal Feeding Operations

Animal feeding operations (AFOs) can pose a number of risks to water quality. To minimize water quality effects from AFOs, the USDA and EPA released the Unified National Strategy for AFOs in 1999 (U.S. Department of Agriculture and U.S. Environmental Protection Agency, 1999). This plan is a written document detailing manure storage and handling systems, surface runoff control measures, mortality management, chemical handling, manure application rates, schedules to meet crop nutrient needs, land management practices, and other options for manure disposal. An AFO that meets certain specified criteria is referred to as a Concentrated Animal Feeding Operation (CAFO), and in addition may be required to obtain a Montana Pollution Discharge Elimination System (MPDES) permit as a point source. Montana's AFO compliance strategy is based on federal law and has voluntary, as well as, regulatory components. If voluntary efforts can eliminate discharges to state waters, in some cases no direct regulation is necessary through a permit. Operators of AFOs may take advantage of effective, low cost practices to reduce potential runoff to state waters, which additionally increase property values and operation productivity. Properly installed vegetative filter strips, in conjunction with other practices to reduce wasteloads and runoff volume, are very effective at trapping and detaining sediment and reducing transport of nutrients and pathogens to surface waters, with removal rates approaching 90 percent (U.S. Department of Agriculture and U.S. Environmental Protection Agency, 1999). Other options may include clean water diversions, roof gutters, berms, sediment traps, fencing, structures for temporary manure storage, shaping, and grading. Animal health and productivity also benefit when clean, alternative water sources are installed to prevent contamination of surface water.

Opportunities for financial and technical assistance (including comprehensive nutrient management plan development) in achieving voluntary AFO and CAFO compliance are available from conservation districts and NRCS field offices. Voluntary participation may aide in preventing a more rigid regulatory program from being implemented for Montana livestock operators in the future.

Further information may be obtained from the DEQ website at: http://www.deq.mt.gov/wqinfo/mpdes/cafo.asp. Montana's NPS pollution control strategies for addressing AFOs are summarized in the bullets below:

- Work with producers to prevent NPS pollution from AFOs.
- Promote use of State Revolving Fund for implementing AFO BMPs.

- Collaborate with MSU Extension Service, NRCS, and agriculture organizations in providing resources and training in whole farm planning to farmers, ranchers, conservation districts, watershed groups and other resource agencies.
- Encourage inspectors to refer farmers and ranchers with potential nonpoint source discharges to DEQ watershed protection staff for assistance with locating funding sources and grant opportunities for BMPs that meet their needs. (This is in addition to funds available through NRCS and the Farm Bill).
- Develop early intervention of education & outreach programs for small farms and ranches that have potential to discharge nonpoint source pollutants from animal management activities. This includes assistance from the DEQ internal (Permitting Division), as well as external entities (DNRC, local watershed groups, conservation districts, MSU Extension, etc.).

6.2.5 Cropland

The primary strategy of the recommended cropland BMPs is to reduce sediment and nutrient inputs. The major factors involved in decreasing sediment loads are reducing the amount of erodible soil, reducing the rate of runoff, and intercepting eroding soil before it enters waterbodies. The main BMP recommendations for the Tobacco TPA are vegetated filter strips (VFS) and riparian buffers. Both of these methods reduce the rate of runoff, promote infiltration of the soil (instead of delivering runoff directly to the stream), and intercept sediment. Effectiveness is typically about 70 percent for filter strips and 50 percent for buffers (DEQ, 2007). Filter strips and buffers are most effective when used in conjunction with agricultural BMPs that reduce the availability of erodible soil such as conservation tillage, crop rotation, strip cropping, and precision farming. Filter strips along streams should be composed of natural vegetative communities which will also supply shade to reduce instream temperatures. Filter strips widths along streams should be at least double the average mature canopy height to assist in providing stream shade. Additional BMPs and details on the suggested BMPs can be obtained from NRCS and in Appendix A of Montana's NPS Management Plan (DEQ, 2007).

6.2.6 Forestry and Timber Harvest

Timber harvest activities should be conducted by all landowners according to Forestry BMPs for Montana (Montana State University, Extension Service, 2001) and the Montana Streamside Management Zone (SMZ) Law (77-5-301 through 307 MCA). The Montana Forestry BMPs cover timber harvesting and site preparation, road building including culvert design, harvest design, other harvesting activities, slash treatment and site preparation, winter logging, and hazardous substances. While the SMZ Law is intended to guide commercial timber harvesting activities in streamside areas (i.e., within 50 feet of a waterbody), the riparian protection principles behind the law should be applied to numerous land management activities (i.e., timber harvest for personal use, agriculture, development). Prior to harvesting on private land, landowners or operators are required to notify the Montana DNRC. DNRC is responsible for assisting landowners with BMPs and monitoring their effectiveness. The Montana Logging Association and DNRC offer regular Forestry BMP training sessions for private landowners. .

The SMZ Law protects against excessive erosion and therefore is appropriate for helping meet sediment load allocations. United States Forest Service (USFS) Inland Fish (INFISH) Riparian Habitat Conservation Area (RHCA) guidelines provide significant sediment protection as well as protection from elevated thermal loading (i.e., elevated temperature) by providing adequate shade. This guidance improves upon Montana's SMZ law and includes an undisturbed 300 foot buffer on each side of fish bearing streams and 150 foot buffer on each side of non-fish bearing streams with limited exclusions and BMP guidance for timber harvest, roads, grazing, recreation and other human sources (U.S. Department of Agriculture, Forest Service, 1995b).

In addition to the BMPs identified above, effects that timber harvest may have on yearly streamflow levels, such as peak flow, should be considered. Water yield and peak flow increases should be modeled in areas of continued timber harvest and potential effects should be evaluated. Furthermore, noxious weed control should be actively pursued in all harvest areas and along all forest roads.

6.2.7 Unpaved Road BMPs

The road sediment reductions in this document represent an estimation of the sediment load that would remain once appropriate road BMPs were applied at all locations. Achieving this reduction in sediment loading from roads may occur through a variety of methods at the discretion of local land managers and restoration specialists. Road BMPs can be found on the Montana DEQ or DNRC websites and within Montana's Nonpoint Source Management Plan (DEQ, 2007). Examples include:

- Providing adequate ditch relief up-grade of stream crossings.
- Constructing waterbars, where appropriate, and up-grade of stream crossings.
- Instead of cross pipes, using rolling dips on downhill grades with an embankment on one side to direct flow to the ditch. When installing rolling dips, ensure proper fillslope stability and sediment filtration between the road and nearby streams.
- Insloping roads along steep banks with the use of cross slopes and cross culverts.
- Outsloping low traffic roads on gently sloping terrain with the use of a cross slope.
- Using ditch turnouts and vegetative filter strips to decrease water velocity and sediment carrying capacity in ditches.
- For maintenance, grade materials to the center of the road and avoid removing the toe of the cutslope.
- Preventing disturbance to vulnerable slopes.
- Using topography to filter sediments; flat, vegetated areas are more effective sediment filters.
- Where possible, limit road access during wet periods when drainage features could be damaged.
- No new roads with long parallel sections within 150 feet of streams. Limit new road stream crossings to the extent practicable.

6.2.8 Culverts and Fish Passage

Although there are a lot of factors associated with culvert failure and it is difficult to estimate the true at-risk load, the culvert analysis found that approximately 62% of the culverts were designed to accommodate a 25-year storm event. The allocation strategy for culverts is no loading from culverts as a result of being undersized, improperly installed, or inadequately maintained. The culvert assessment included 47 culverts in the watershed and it is recommended that the remaining culverts be assessed so that a priority list may be developed for culvert replacement. Because of the high road densities and resulting large number of culverts throughout most of the Tobacco watershed, as culverts fail, they should be replaced by culverts that pass a 100 year flood on fish bearing streams and at least 25 year events on non fish bearing streams. Some road crossings may not pose a feasible situation for upgrades to these sizes because of road bed configuration; in those circumstances, the largest size culvert feasible should be used. If funding is available, culverts should be prioritized and replaced prior to failure.

Another consideration for culvert upgrades should be fish and aquatic organism passage. A coarse assessment of fish passage indicated that a large percentage of culverts may pose a fish passage risk at all flows. Each fish barrier should be assessed individually to determine if it functions as an invasive species and/or native species barrier. These two functions should be weighed against each other to determine if each culvert acting as a fish passage barrier should be mitigated. Montana FWP can aid in determining if a fish passage barrier should be mitigated, and, if so, can aid in culvert design.

6.2.9 Stormwater Construction Permitting and BMPs

Construction activities disturb the soil, and if not managed properly, they can be substantial sources of sediment. Construction activity disturbing one acre or greater is required to obtain permit coverage through DEQ under the Stormwater General Permit for Construction Activities. A Stormwater Pollution Prevention Plan (SWPPP) must be developed and submitted to obtain a permit. A SWPPP identifies pollutants of concern, which is most commonly sediment, construction related sources of those pollutants, any nearby waterbodies that could be affected by construction activities, and BMPs that will be implemented to minimize erosion and discharge of pollutants to waterbodies. The SWPPP must be implemented for the duration of the project, including final stabilization of disturbed areas, which is a vegetative cover of at least 70% of the pre-disturbance level or an equivalent permanent stabilization measure. Development and implementation of a thorough SWPPP should ensure WLAs within this document are met.

Land disturbance activities that are smaller than an acre (and exempt from permitting requirements) also have the potential to be substantial pollutant sources, and BMPs should be used to prevent and control erosion consistent with the upland erosion allocations. Potential BMPs for all construction activities include construction sequencing, permanent seeding with the aid of mulches or geotextiles, check dams, retaining walls, drain inlet protection, rock outlet protection, drainage swales, sediment basin/traps, earth dikes, erosion control structures, grassed waterways, infiltration basins, terraced slopes, tree/shrub planting, and vegetative buffer strips. An EPA support document for the construction permits has extensive information about construction related BMPs, including limitations, costs, and effectiveness (EPA 2009).

6.2.10 Urban Area Stormwater BMPs

Even though the Eureka area does not have a large enough population to require a municipal stormwater permit, activities to reduce sediment or other pollutant loading from new development or redevelopment should be pursued consistent with the upland erosion allocations and efforts to avoid future water quality problems. Any BMPs which promote onsite or after collection infiltration, evaporation, transpiration or reuse of the initial flush stormwater should be implemented as practicable on all new or redevelopment projects. EPA provides more comprehensive information about stormwater best management practices on their website at:
http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm

6.2.11 Beaver Populations and Sediment Yields

Historic heavy trapping of beavers has likely had an effect on sediment yields in the watershed. Before the removal of beavers, many streams had a series of catchments that moderated flow, with smaller unincised multiple channels and frequent flooding. Now some stream segments have incised channels and are no longer connected to the floodplain. This results in more bank erosion because high flows scour streambanks to a greater extent instead of flowing onto the floodplain. Beaver ponds also capture and store sediment and there can be large reductions in total suspended solids (TSS) concentrations below a beaver impoundment in comparison to TSS concentrations above the beaver impoundment (Bason, 2004)

Management of headwaters areas should include consideration of beaver habitat. Long-term management could include maintenance of beaver habitat in headwaters protection areas and even allowing for increased beaver populations in areas currently lacking the beaver complexes that can trap sediment, reduce peak flows, and increase summer low flows. Allowing for existing and even increased beaver habitat is considered consistent with the sediment TMDL water quality goals.

6.2.12 Nonpoint Source Pollution Education

Because most nonpoint source pollution (NPS) is generated by individuals, a key factor in reducing NPS is increasing public awareness through education. The KRN can provide educational opportunities to both students and adults through local water quality workshops, informational meetings and field trips to locations with successful BMP implementation or restoration project success. Continued education is key to ongoing understanding of water quality issues in the Tobacco TPA, and to the support for implementation and restorative activities.

6.3 Monitoring Recommendations

The monitoring framework discussed in this section is an important component of watershed restoration, a requirement of TMDL development under Montana's TMDL law, and the foundation of the adaptive management approach. While targets and allocations are calculated using the best available data, the data are only an estimate of a complex ecological system. The margin of safety is put in place to reflect some of this uncertainty, but other issues only become apparent when restoration strategies are underway. Having a monitoring strategy in place allows for feedback on the effectiveness of restoration activities (whether TMDL targets are being met), if all significant sources have been identified, and whether attainment of TMDL targets is feasible. Data from long-term monitoring programs also provide technical justifications to modify restoration strategies, targets, or allocations where appropriate.

The monitoring framework presented in this section provides a starting point for the development of more detailed and specific planning efforts regarding monitoring needs; it does not assign monitoring responsibility. Monitoring recommendations provided are intended to assist local land managers, stakeholder groups, and federal and state agencies in developing appropriate monitoring plans to meet aforementioned goals. Funding for future monitoring is uncertain and can vary with economic and political changes. Prioritizing monitoring activities depends on stakeholder priorities for restoration and funding opportunities.

The objectives for future monitoring in the Tobacco TPA include: 1) tracking and monitoring restoration activities and evaluating the effectiveness of individual and cumulative restoration activities, 2) baseline and impairment status monitoring to assess attainment of water quality targets and identify long-term trends in water quality and 3) refining the source assessments. Each of these objectives is discussed below.

6.3.1 Tracking and Monitoring Restoration Activities and Effectiveness

Restoration activities which address nonpoint sources should be tracked watershed-wide as they are implemented. Information about specific locations, spatial extent, designs, contact information, and any effectiveness evaluation should be compiled about each project as they occur.

Monitoring should be conducted prior to and after project implementation to help evaluate the effectiveness of specific practices or projects. This approach will help track the recovery of the system and the effects, or lack of effects, from ongoing management activities in the watershed. At a minimum, effectiveness monitoring should address the pollutants that are targeted for each project.

Particularly for sediment, which has no numeric standard, effectiveness and reductions in loading should be evaluated using load estimate approaches applied within this document for each source category. Evaluating in-stream parameters used for sediment targets will not be practical for most projects since the sediment effects within a stream represent cumulative effects from many watershed scale activities.

Information about all restoration projects along with tracking overall extent of BMP implementation should be compiled into one location. If sufficient implementation progress is made within a watershed, DEQ will create a monitoring plan to assess target conditions and implement the monitoring. Results would be compared to targets to determine if the TMDL is achieved.

Forestry BMP audits represent an important monitoring tool to assist in evaluating forest practices BMP implementation and effectiveness. The statewide audits are conducted biennially by an interdisciplinary team comprised of persons from local, state and federal agencies as well as private companies and non-profit organizations. The audits look at road BMPs as well as timber harvest operations on the upland and in the riparian area. Whenever one of these audits occurs within the Tobacco watershed, the results can help evaluate if the individual or agency that sponsored the timber harvest is pursuing BMPs in a manner consistent with the applicable sediment TMDLs.

6.3.2 Baseline and Impairment Status Monitoring

Monitoring should continue to be conducted to expand knowledge of existing conditions and also collect data that can be evaluated relative to the water quality targets. Although DEQ is the lead agency for developing and conducting impairment status monitoring, other agencies or entities may collect and provide compatible data. Wherever possible, it is recommended that the type of data and methodologies used to collect and analyze the information be consistent with DEQ methodology so as to allow for comparison to TMDL targets and track progress toward meeting TMDL goals. The information in this section provides general guidance for future impairment status monitoring.

For sediment investigation in the Tobacco TPA, each of the streams of interest was stratified into unique reaches based on physical characteristics and anthropogenic influence. The assessed sites represent only a percentage of the total number of stratified reaches. Sampling additional monitoring locations to represent some of the various reach categories that occur could provide additional data to assess existing conditions, and provide more specific information on a per stream basis as well as the TPA as a whole.

It is acknowledged that various agencies and entities have differing objectives, as well as time and resources available to achieve those objectives. However, when possible, when collecting sediment and habitat data it is recommended that at a minimum the following parameters be collected to allow for comparison to TMDL targets:

- Riffle pebble count; using Wolman Pebble Count methodology and/or 49-point grid tosses in riffles and pool tails
- Residual pool depth and pool frequency measurements
- Greenline assessment

Additional information will undoubtedly be useful and assist impairment status evaluations in the future and may include total suspended solids, identifying percentage of eroding banks, human sediment sources, areas with a high background sediment load, macroinvertebrate studies, McNeil core sediment samples, and fish population surveys and redd counts.

An important part of impairment determination and adaptive management is determining when a stream has fully recovered from past management practices where BMPs were not applied. This is particularly important in the Tobacco watershed, and ongoing PACFISH/INFISH Biological Opinion Effectiveness Monitoring Program (PIBO) activity can provide critical insight into the extent of recovery from past practices via comparisons between reference and managed sites within the Tobacco watershed.

6.3.3 Source Assessment Refinement

In many cases, the level of detail provided by the source assessments only provides broad source categories or areas that need to reduce pollutant loads and additional source inventory and load estimate work may be desirable. Strategies for strengthening source assessments for each of the pollutants may include more thorough sampling or field surveys of source categories such as bank erosion or road crossings to help prioritize implementation strategies based on an assessment of a larger population of eroding banks or road crossings of concern. Culverts should be assessed for fish passage and their capacity to pass storm event flows as culvert failure is often a source of discrete sediment loads.

Efforts to improve upon load estimates, either within a given source category or via a calibrated approach to allow improved comparison between source categories is also a possibility, but not a requirement for TMDL implementation. Improvements might include:

- a refined bank erosion retreat rate for Tobacco watershed streams,
- a better understanding of bank erosion impacts from historical land management activities,
- improved modeling for upland erosion delivery in forested watersheds where riparian zones have recovered from SMZ law implementation,
- evaluation of seasonal loading aspects for the major sources and potential implications regarding TMDL target parameters, and
- evaluation of “hot spots” that simple watershed scale models may not adequately address, such as a confined animal operation adjacent to a stream.

7.0 PUBLIC PARTICIPATION

Stakeholder and public involvement is a component of TMDL planning supported by EPA guidelines and required by Montana state law (MCA 75-5-703, 75-5-704) which directs DEQ to consult with watershed advisory groups and local conservation districts during the TMDL development process. Technical advisors, stakeholders and interested parties, state and federal agencies, interest groups, and the public were solicited to participate in differing capacities throughout the TMDL development process in the Tobacco TMDL Planning Area (TPA).

7.1 PARTICIPANTS AND ROLES

Throughout completion of the Tobacco planning area sediment TMDLs, DEQ worked with stakeholders to keep them apprised of project status and solicited input from a TMDL advisory group. A description of the participants in the development of the sediment TMDLs in the Tobacco TPA and their roles is contained below.

Montana Department of Environmental Quality
Montana state law (MCA 75-5-703) directs DEQ to develop all necessary TMDLs. DEQ has provided resources toward completion of theses TMDLs in terms of staff, funding, internal planning, data collection, technical assessments, document development, and stakeholder communication and coordination. DEQ has worked with other state and federal agencies to gather data and conduct technical assessments. DEQ has also partnered with watershed organizations to collect data and coordinate local outreach activities for this project.

United States Environmental Protection Agency
EPA is the federal agency responsible for administering and coordinating requirements of the Clean Water Act (CWA). Section 303(d) of the CWA directs states to develop TMDLs (see **Section 1.1**), and EPA has developed guidance and programs to assist states in that regard. EPA has provided funding and technical assistance to Montana's overall TMDL program. Project management support was provided by the EPA Regional Office in Helena, MT, including assistance developing the sediment water quality targets, assessing data and making TMDL determinations, developing the document, and providing technical review.

Kootenai River Network
The Kootenai River Network (KRN) is a non-profit organization whose primary purpose is to foster communication and implement collaborative processes among private and public interests in the Kootenai River watershed and basin. They strive to improve resource management practices and restore water quality and aquatic resources in the basin. Membership in the KRN includes representatives from the U.S. Fish and Wildlife Service; Natural Resources Conservation Service; Montana Fish, Wildlife and Parks; Lincoln Conservation District; and Plum Creek Timber Company; among other organizations.

The KRN administered several contracts with DEQ to conduct tasks in support of TMDL development, including data collection and technical assessments through third party contracting and coordination of local stakeholder outreach activities. The KRN provided invaluable assistance to DEQ in: identifying stakeholders and members of a Tobacco TMDL advisory group, providing information on local water quality concerns, helping obtain access to private property for stream sediment monitoring and assessment purposes, and coordinating advisory group meetings and public meetings. This collaborative effort between DEQ and the KRN will continue through future TMDL development projects in the Tobacco River watershed and the entire Kootenai River watershed in Montana.

Conservation Districts

Majority of the Tobacco TMDL Planning Area falls within Lincoln County; however a small portion of the Lime Creek drainage is located in Flathead County. Therefore, DEQ provided both the Lincoln Conservation District and the Flathead Conservation District with consultation opportunity during development of the sediment TMDLs. This included opportunities to provide comment during the various stages of TMDL development, and an opportunity for participation in the advisory group discussed below.

Tobacco TMDL Advisory Group

The Tobacco TMDL Advisory Group consisted of selected resource professionals who possess a familiarity with water quality issues and processes in the Tobacco River watershed, and also representatives of applicable interest groups. All members were solicited to participate and work with DEQ and the Lincoln and Flathead conservation districts in an advisory capacity per Montana state law (75-5-703 and 704). DEQ requested participation from the interest groups defined in MCA 75-5-704 and included local city and county representatives, livestock-oriented and farming-oriented agriculture representatives, conservation groups, watershed groups, state and federal land management agencies, and representatives of recreation and tourism interests. The advisory group also included additional stakeholders and landowners with an interest in maintaining and improving water quality and riparian resources, including the Glen Lake Irrigation District.

Advisory group involvement was voluntary and the level of involvement was at the discretion of the individual members. Members had the opportunity to provide comment and review of technical TMDL assessments and reports and to attend meetings organized by DEQ and the KRN for the purpose of soliciting feedback on project planning. Typically, draft documents were released to the advisory group for review under a limited timeframe, and their comments were then compiled and evaluated. Final technical decisions regarding document modifications resided with DEQ.

Communications with the group members was typically conducted through email and draft documents were made available through DEQ's wiki for TMDL projects (http://montanatmdlflathead.pbworks.com). Opportunities for review and comment were provided for participants at varying stages of TMDL development, including opportunity for review of the draft TMDL document prior to the public comment period.

7.2 Response to Public Comments

Upon completion of the draft TMDL document, and prior to submittal to EPA, DEQ issues a press release and enters into a public comment period. During this timeframe, the draft TMDL document is made available for general public comment, and DEQ addresses and responds to all formal public comments.

The formal public comment period for the "Tobacco Planning Area Sediment TMDLs and Framework Water Quality Improvement Plan" was initiated on July 20, 2011 and closed on August 22, 2011. Electronic copies of the draft document were made available at the Flathead County, Eureka, Libby, and Whitefish Branch public libraries and at the State Library in Helena, MT.

A public informational meeting and open house was held in Eureka, MT on August 11, 2011. DEQ provided an overview of the document, answered questions, and solicited public input and comment on the TMDLs. The announcement for the meeting was distributed to the KRN, Lincoln and Flathead conservations districts, the Tobacco TMDL Advisory Group, the Statewide TMDL Advisory Group, and other identified interested parties via email. Notice of the meeting was posted on the DEQ webpage and DEQ wiki, and also advertised in the following newspapers: Daily Interlake, Missoulian, The Western News, and Tobacco Valley News. The comments received during the public comment period and DEQ responses to these comments are presented within **Appendix I**.

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